THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 63 AUGUST, 1937 No. 4

RICHARD CRITTENDEN McGREGOR

BY CHARLES P. ALEXANDER

Of Amherst, Massachusetts

ONE PLATE

It is with the most profound regret and a feeling of irreparable loss that I have just heard of the death of Richard Crittenden McGregor.[1] I would ask to be permitted to write a little concerning the influence of McGregor in the development of our knowledge of the Tipulidæ of the Philippines. I have been in constant communication with him for more than a dozen years, and during that period have received from him scores of helpful and instructive letters.

Our earliest knowledge of the Philippine Tipulidæ had been derived from the fragmentary collections made by Carl Semper (1859–1864), later discussed by Osten Sacken (1882). Still later, the intermediate collections made by G. Boettcher (1913–1918) and Charles Fuller Baker (1912–1926) had been studied and discussed by Bezzi (1917), Edwards (1926), and the pres-

[1] McGregor was closely associated with the Philippine Journal of Science already at the time this publication replaced the Publications of the Bureau of Government Laboratories in 1906. Volume 1, published in 1906, already contains results of his work on Philippine birds. In 1908 he became officially connected with it in an editorial capacity. From that time on more and more of the editorial details devolved upon him, a fact that was given official recognition in 1919, when he was named Associate Editor. With the reorganization of the Department of Agriculture and Natural Resources into the Department of Agriculture and Commerce, in 1933, he became Chief of the Division of Publications, and from that time until his death, December 30, 1936, he was Managing Editor of the Philippine Journal of Science.—EDITOR.

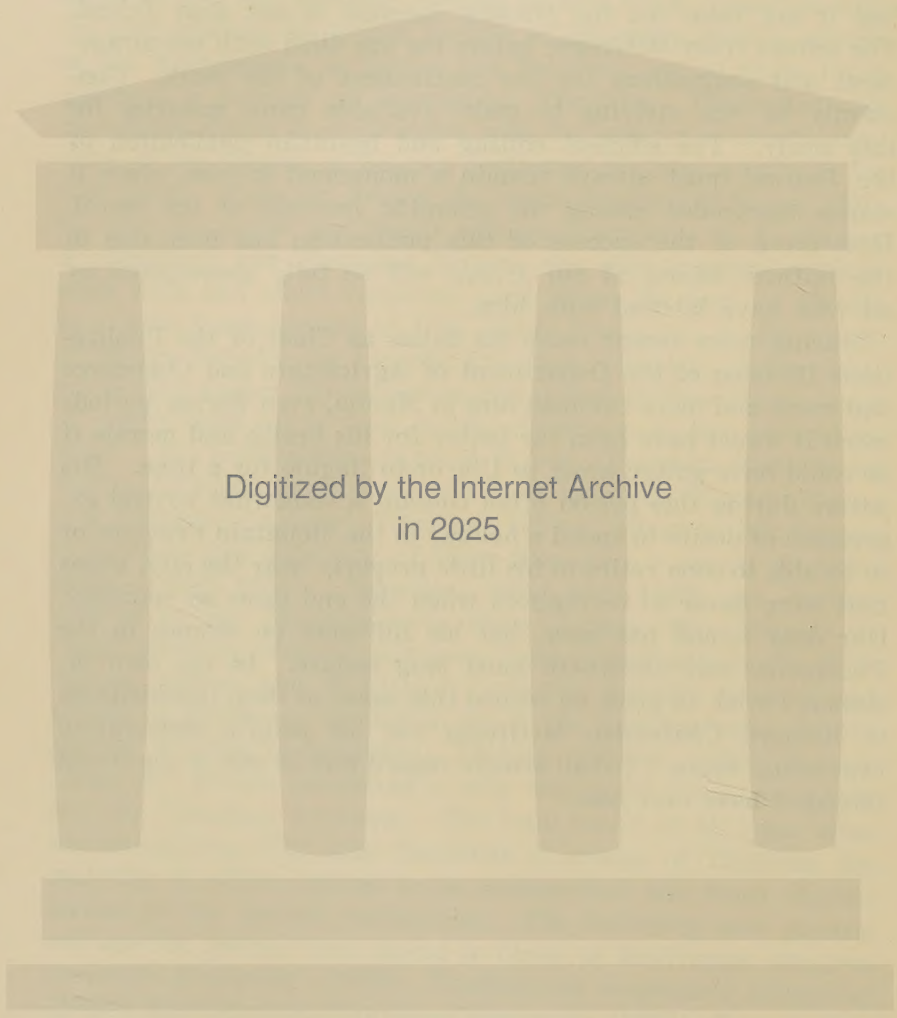
ent writer (Alexander, 1922–1927). The sum total of all of the above efforts had produced a list of the crane flies of the Islands that obviously was still fragmentary.

About 1924[2] I began corresponding with McGregor and thenceforth received his fullest coöperation in making known the involved tipulid fauna of the Philippines. In the earlier years, while he was still actively engaged in field work connected with his bird studies, he visited certain of the more remote islands of the Archipelago, as Samar and Palawan, and at these times collected a number of interesting Tipulidæ. Thereafter, his increasing duties in conjunction with the editing of the publications of the Bureau of Science restricted his time available for field work. However, during the period between 1928 and 1930, he, with his active and highly efficient coworkers, A. C. Duyag, A. Celestino, and Francisco Rivera, was able to spend various week ends and short vacations away from the heat of Manila in a little house located at Ube, above Majayjay, on the slopes of Mount Banahao in Laguna Province. Several of our most interesting Luzon Tipulidæ were discovered at these times, some of which have never been taken elsewhere in the succeeding years. His enthusiasm inspired Duyag (Benguet, Novaliches; Tablas; Sibuyan; Mindanao) and more especially Rivera (Mountain Province, Cagayan, Tayabas; Tablas; Sibuyan; Mindanao) to continue the collecting of these flies over a period of many years (1924–1934). Between 1930 and 1932 my former student at the Massachusetts State College, Mr. Charles F. Clagg, likewise collected numerous insect specimens in the Philippines (Luzon and Mindanao), and the friendly interest and advice of McGregor proved to be of the greatest value in the success of this undertaking. During October, 1931, Messrs. Clagg and Rivera conducted a very successful joint expedition into the Mountain Province. The total result of all these trips and expeditions was some hundreds of species of Tipulidæ, the majority of which proved to be undescribed and were characterized in the present publication. The following new generic and specific groups were named in honor of McGregor: *Macgregoromyia* Alexander (1929); *Pselliophora mcgregori* Alexander (1925), *Styringomyia mcgregori* Alexander (1925), *Trentepohlia* (*Trentepohlia*) *mcgregori* Alexander (1927), and *Trentepohlia* (*Mongoma*) *ricardi* Alexander (1930).

[2] Philip. Journ. Sci. 27 (1925) 71–81.

During the past fifteen years I have published in the Philippine Journal of Science more than fifty reports on the Tipulidæ of the Philippines and elsewhere in eastern Asia. I regard this series of papers as being unquestionably the most valuable and important single study that I have made and can unhesitatingly affirm that little of this could have been accomplished had it not been for the friendly interest of my dear friend. The letters from McGregor before me are filled with encouragement and suggestions for the continuance of the work. Constantly he was striving to make available more material for this study. The efficient editing and beautiful publication of the Journal must always remain a monument to him, since it stands unexcelled among the scientific journals of the world. How much of the success of this publication has been due to the faithful efforts of our friend will be fully appreciated by all who have labored with him.

During more recent years his duties as Chief of the Publications Division of the Department of Agriculture and Commerce had more and more confined him to Manila, even during periods when it would have been far better for his health and morale if he could have gotten away to Ube or to Baguio for a time. His letters during this period often contain a somewhat wistful expression of desire to spend a holiday in the Mountain Province or to be able to soon retire to his little property near the city, hopes that were never to be realized when the end came so suddenly. Our dear friend has gone, but his influence on science in the Philippines and elsewhere must long endure. In my own instance, I wish to place on record this sense of deep indebtedness to Richard Crittenden McGregor for his helpful coöperation over many years. I shall always regard him as one of the truest friends I have ever had.



Digitized by the Internet Archive
in 2025

https://archive.org/details/philippine-journal-of-science_1937-08_63_4

ILLUSTRATION

PLATE 1. Richard Crittenden McGregor, 1871–1936.
363

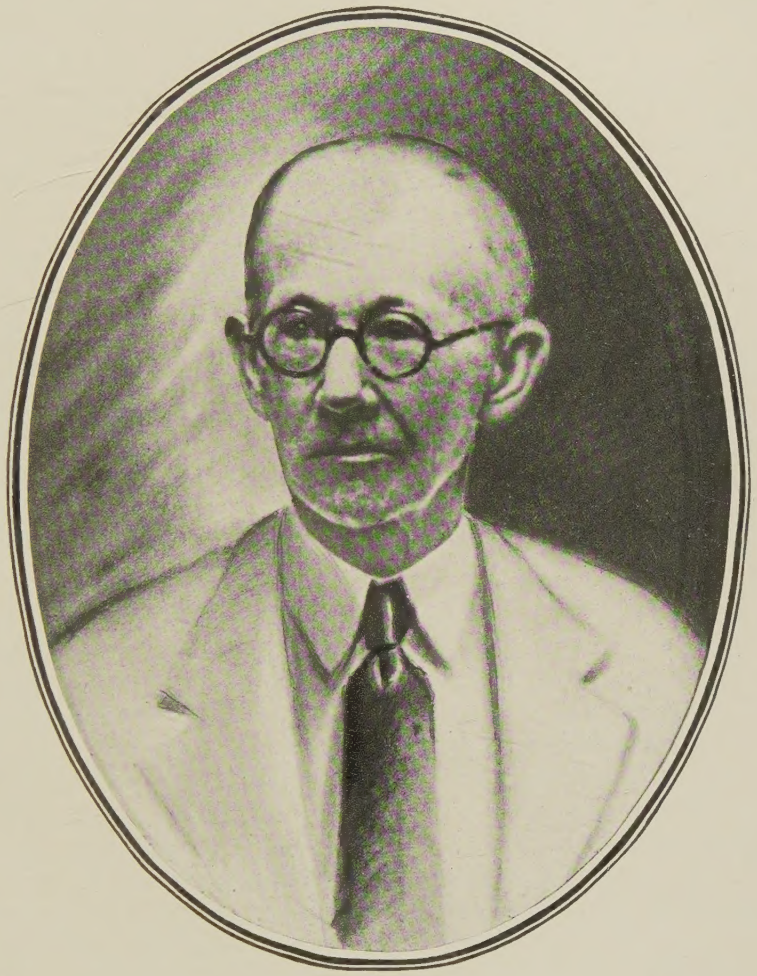


PLATE 1.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXV[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

THREE PLATES

Virtually all of the species discussed in the present report are from southeastern China, where they were collected in 1936 by Mr. J. Linsley Gressitt. A few additional species are from Java, collected by Mrs. M. E. Walsh. I am very greatly indebted to Mr. Gressitt and to Mrs. Walsh for the privilege of retaining the materials in my collection of crane flies.

Our knowledge of the distribution of the Tipulidæ in eastern China is still so fragmentary that I am supplying records of many of the species. Several of these had been known hitherto only from Formosa, while still others had been recorded only from the mountains of Szechwan, western China. I am indebted to Mr. Gressitt for the following notes on the stations in southeastern China, where collections of Tipulidæ were made in 1936.

KWANGTUNG PROVINCE.

Mei-hsien (Kaying, Moejen). Altitude 715 feet (May 29 to June 1; June 7 to 10, and 17 to 20; July 28 to 30). Fairly large city in eastern Kwangtung, about equidistant from Kiangsi and Fukien boundaries, located on the Mei River, a branch of the Han River. Environs largely grassy or cultivated; scattered pines on the hills; valleys with native fruit trees, banyans, bamboos, and others.

Tai-yong. Altitude 2,090 feet (August 2 to 7). Small summer resort in eastern Kwangtung, about 80 kilometers west-northwest of Swatow, northwest of Wu-king-fu, in a cultivated mountain valley, encircled by partly wooded mountains.

Tsin-leong-san (Clear Cool Mountain). Altitude 2,750 feet (June 1 to 7). Small mountain resort in Mei-hsien district, about 18 kilometers south-southwest of Mei-hsien city, located near the summit (3,120 feet) of the range. Mountain partly

[1] Contribution from the Department of Entomology, Massachusetts State College.

grassy, partly with dense shrubbery, low forests, *Cunninghamia*, small swamps, or cultivated tea.

Yim-na-san (Yam-na-shan). Collections at 1,800 feet; summit 4,225 feet (June 10 to 17). Sacred mountain in Mei-hsien district, eastern Kwangtung, about 40 kilometers northeast of Mei-hsien City. Dense forests in canyons and behind monastery; ridges grassy, with *Pinus; Cryptomeria* before Monastery.

KIANGSI PROVINCE.

Hong San. Altitude 5,100 feet (June 21 to July 1; July 14 to 17). Probably the highest mountain (5,200 feet) in regions visited. Located in southeastern corner of Kiangsi, east of Sungwu, very near the Kwangtung and Fukien borders. Densely forested on upper slopes; rice fields in valleys on either side. First half of first visit spent at village (altitude 2,115 feet) in enclosed valley at foot of west side, collecting up side; remainder spent in hut at edge of jungle on south side (altitude 3,100 feet). Second visit spent on east side of pass at north end of mountain.

Tai-au-hong. Altitude 1,750 feet (July 3 to 8). Group of small hamlets in small valley in southeastern Kiangsi, near Kwangtung border, below pass in range. Canyons with fairly dense forest in part; much *Cunninghamia*-lumbered; ridges grassy.

Wong-sa-shue. Altitude 1,900 feet (July 8 to 12). Small village between Sungwu and Tai-au-hong, in southeastern Kiangsi. Collecting done on forested slopes of Ng-tze-san, above and below a small shrine, from foot (1,600 feet) to summit (3,175 feet). Dense jungles; conifers on upper parts; tea cultivated; tigers present.

FUKIEN PROVINCE.

Gang-keu. Altitude 1,900 feet (July 22 to 28). Small village in southwestern Fukien, south of Shanghang and between Liung-chon-san and Ngam-chen. At the edge of a flattish valley and at the foot of a steeply rising range, part of the Leong San system. Mountain side and narrow canyons, largely with dense jungle, with trails. Pythons reported as frequent; tigers occasional.

Liung-chon-san. Altitude 2,525 feet (July 20 to 22, and 27). Small range in the Leong San system, 25 kilometers south of Shanghang, in southwestern Fukien. Summit about 3,400 feet, largely unforested; lower slopes with groves of bamboo, *Pinus* and *Cunninghamia*, with mixed forests or bushy areas in parts.

PTYCHOPTERIDÆ

PTYCHOPTERA BELLULA sp. nov. Plate 1, fig. 1.

General coloration black; halteres black, the base of stem restrictedly yellow; femora yellow, the tips narrowly and insensibly darkened; wings subhyaline, heavily patterned with brown; Rs long, about three-fifths the length of R_{4+5}; abdomen black, the proximal ends of the basal tergites yellow, most conspicuous on segment four.

Male.—Length, about 6.5 millimeters; wing, 6.2; antenna, about 3.

Female.—Length, about 7 to 7.2 millimeters; wing, 6.3 to 6.5.

Rostrum yellow; basal segment of palpi brownish yellow, the outer segments dark brown, the elongate terminal segment paler basally than at outer end. Antennæ of male of moderate length, as shown by the measurements; scape and pedicel (male) yellow, of female brownish black; basal segment of flagellum yellow, succeeding segments dark brown; in the female the antennæ are shorter. Head polished black; anterior vertex wide.

Thorax black, the dorsopleural membrane buffy. Halteres black, the base of stem restrictedly yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips narrowly and insensibly darkened, more extensively so on the forelegs; tibiæ yellowish brown to brown; tarsi brownish black. Wings (Plate 1, fig. 1) subhyaline, heavily patterned with brown, as follows: A major area in bases of cells R and M; a large quadrate area at origin of Rs; a broad band at cord, extending from R to the bend in the distal section of Cu_1, a broad band across outer forks, extending from costa to beyond the fork of M_{1+2}; an oval area at near midlength of vein M_3; wing tip paler brown; in cases, the dark area at cord confluent with that at origin of Rs; veins brown, slightly darker in the clouded areas. Macrotrichia of cells abundant, indicated in the figure by stippling. Venation: Rs long, about three-fifths R_{4+5}; fork of M_{1+2} about one-half as deep as that of vein R_{4+5}.

Abdominal tergites black, in the male with bases of segments two to four yellow, becoming more extensive on the outer segments, especially the fourth; in the female, abdomen chiefly darkened, except for the basal half of the fourth segment; outer segments, including hypopygium, black, the appendages of the latter a little paler; basal sternites yellow, the subterminal segments black.

Habitat.—China (Kiangsi).

Holotype, male, Hong San, altitude 2,925 feet, June 30, 1936 (*Gressitt*). Allotopotype, female, altitude 3,000 feet, June 28, 1936. Paratopotypes, 2 females, altitude 3,000 to 3,160 feet, June 27 to 28, 1936.

Ptychoptera bellula is very different from the other described regional species having Rs elongate, such as *P. clitellaria* Alexander, of western China, and *P. daimio* Alexander, of northern Japan, especially in the small size and conspicuous wing pattern. In the latter respect, the present fly somewhat resembles *P. japonica* Alexander, of Japan, but is readily told by the short antennæ and venation, as the length of Rs.

PTYCHOPTERA JAVENSIS sp. nov. Plate 1, fig. 2.

Head deep blue; mesonotal præscutum opalescent, the ground color black with three light castaneous stripes; scutellum black; postnotum and pleura uniformly reddish yellow; femora yellow, the tips very narrowly and abruptly black; wings pale yellowish subhyaline, with narrow brown bands at cord and across the outer forks; Rs short, less than r-m; abdomen yellow, the tergites narrowly ringed caudally with brownish black; hypopygium large and complicated, yellow.

Male.—Length, about 9 millimeters; wing, 8.5; antenna, about 5.5.

Rostrum brownish yellow; palpi pale brown, the outer segments dark brown. Antennæ of male relatively elongate, exceeding one-half the length of body; scape, pedicel, and base of first flagellar segment, yellow, the remainder of organ black; flagellar segments long-cylindrical, with a short dense pubescence and relatively short, unilaterally arranged, black verticils. Head deep blue.

Mesonotal præscutum opalescent, the ground color black, the three usual stripes light castaneous, the laterals confluent with the similarly colored scutal lobes; scutellum small, black; mediotergite entirely light castaneous brown to obscure reddish yellow. Pleura and pleurotergite uniformly reddish yellow. Halteres blackened, the base of stem restrictedly yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips very narrowly but abruptly black, the amount subequal on all legs; tibiæ and basitarsi testaceous-yellow, the tips narrowly darkened, especially of the latter; remainder of tarsi black. Wings (Plate 1, fig. 2) pale yellowish subhyaline, the prearcular and costal regions deeper yellow; a narrow brown crossband along

cord, extending from R to the bend of the distal section of Cu_1; a second band across the outer forks, from R_2 to beyond midlength of vein M_2; wing tip in outer radial field restrictedly and vaguely darkened; veins dark, yellow in the flavous areas, including the basal portions of veins Cu_1 and Cu_2. Abundant macrotrichia in outer cells (indicated in the figure by stippling), in outer end of cell R and basal half of cell R_5 appearing as a linear series at near midwidth of the cells. Venation: Rs short, less than r-m.

Abdomen yellow, the tergites narrowly ringed caudally with brownish black; subterminal segments more uniformly blackened; hypopygium yellow, large, and very complicated in a structure.

Habitat.—East Java.

Holotype, male, Soember Brantas, Mount Ardjano, altitude 6,000 feet, January 1936 (*Walsh*).

Ptychoptera javensis is most closely allied to *P. annandalei* Brunetti, of Burma, *P. formosensis* Alexander, of Formosa, and *P. sumatrensis* Alexander, of southern Sumatra, differing from all in the coloration of the body and in the structure of the male hypopygium. The species is of unusual interest in that it adds the family Ptychopteridæ to the known dipterous fauna of Java and in that it provides the most easterly record of any species in Asia. Whether any member of the family will be found to the east of Wallace's Line, in Wallacea or Australasia, remains in question.

TIPULIDÆ

TIPULINÆ

DOLICHOPEZA (SINOROPEZA) PAUCISETOSA sp. nov. Plate 1, fig. 3.

General coloration brownish black to black, the præscutum with three polished, more brown, stripes; wings with a strong brown tinge, cells C and Sc a little darker; stigma dark brown; very sparse macrotrichia in extreme outer ends of cells R_3 and R_5; Sc_2 ending about opposite fork of the short oblique Rs; abdomen, including genitalia, black.

Female.—Length, about 9 millimeters; wing, 12 to 12.2.

Rostrum brownish black; palpi black. Antennæ with scape and pedicel brownish yellow; flagellum black; flagellar segments cylindrical, with short inconspicuous verticils. Head brownish black; anterior vertex wide.

Mesonotum almost uniformly black or brownish black, the præscutum with three polished, more brownish, stripes; disc of

mediotergite with long, coarse, black setæ. Pleura brownish black. Halteres black, the stem a trifle paler. Legs long and slender, black throughout. Wings (Plate 1, fig. 3) with a strong brown tinge, cells C and Sc a trifle darker; stigma long-oval, dark brown; cord, extreme wing tip, and certain of the longitudinal veins narrowly and vaguely seamed with brown; veins dark. Very sparse macrotrichia in outer ends of cells R_3 and R_5 (shown in the figure by stippling). Venation: Sc_2 ending about opposite the fork of the short oblique Rs; free tip of Sc_2 lying some distance before the short spur of vein R_{1+2}; R_1 in direct longitudinal alignment with $Sc_2 + R_1$; petiole of cell M_1 a little shorter than that of cell M_2.

Abdomen, including the genitalia, black. Ovipositor with the valves fleshy and obtuse, with long setæ.

Habitat.—China (Kiangsi).

Holotype, female, Hong San, altitude 3,160 feet, June 27, 1936 (*Gressitt*). Paratopotype, female, altitude 3,150 feet, June 27, 1936.

The only other species of the subgenus having macrotrichia in the cells of the wing is the subgenotype, *Dolichopeza* (*Sinoropeza*) *pluricoma* Alexander, of western China. This differs conspicuously in the smaller size, distinct wing pattern, and coloration of the legs, and in the abundant macrotrichia in the outer cells of the wing. In this latter species Rs is longer, less transverse, and about one-half as long as vein R_{2+3}; in the present fly Rs is very short, not exceeding one-third the length of R_{2+3}.

DOLICHOPEZA (NESOPEZA) FABELLA sp. nov. Plate 1, fig. 4.

General coloration of mesonotum dark brown; pleura chiefly testaceous-yellow, the pleurotergite and ventral pleurites darkened; femora brownish yellow, tibiæ and tarsi white; wings tinged with brownish, the tip darker; stigma oval, dark brown, preceded and followed by extensive whitish areas; restricted macrotrichia in cells R_3 to 2d M_2 inclusive; Rs longer than m-cu; abdomen dark brown, tergite two with a conspicuous white area on sides at near midlength; sternites brownish black, narrowly ringed with whitish.

Sex?—Wing, 7 millimeters.

Rostrum and palpi dark. Antennæ elongate, if bent backward extending to opposite the end of the second abdominal segment or beyond scape, pedicel and base of first flagellar seg-

ment brownish yellow, the remainder of organ brownish black; flagellar segments long-cylindrical, with coarse erect setæ but without conspicuous longer differentiated verticils; from the length of the antennæ it seems virtually certain that the type is a male. Head brown, the center of vertex with a narrow darker vitta; anterior vertex wide.

Mesonotum uniformly dark brown, without markings, only the humeral region of præscutum vaguely brightened. Pleura chiefly testaceous-yellow, the propleura, ventral sternopleurite, and meron abruptly dark brown; pleurotergite dark. Halteres elongate, dark brown, the base of stem restrictedly pale. Legs with the fore coxæ darkened, remaining coxæ and all trochanters yellow; femora brownish yellow, the tips very narrowly to scarcely darkened; tibiæ snowy white, the tips very narrowly darkened; tarsi white. Wings (Plate 1, fig. 4) with a weak brown tinge, the tip darker; stigma oval, dark brown, preceded and followed by extensive whitish areas; cord vaguely clouded with darker; veins dark brown. Restricted macrotrichia in cells at wing tip, including R_3 to 2d M_2. Venation: Sc_2 ending just before fork of Rs; free tip of Sc_2 a short distance before level of R_2 but with no trace of R_{1+2}; Rs arcuated, longer than R_{2+3}; vein M before m-cu strongly arcuated; m-cu more than one-half its length before the fork of M; cell 2d A narrow.

Abdomen broken at midlength; dark brown, tergite 2 with a conspicuous whitened area on sides at near midlength; basal sternites brownish black, narrowly ringed with whitish.

Habitat.—China (Kwangtung).

Holotype, Sex?, Tai-yong, altitude 2,075 feet, August 6, 1936 (*Gressitt*).

The nearest described ally of the present fly is *Dolichopeza (Nesopeza) pallidithorax* de Meijere (Java), which is similarly a small species having macrotrichia in the distal wing cells. The present fly differs in the coloration of the body and legs and in the details of venation, as the shorter, more arcuated Rs and the position of m-cu closer to the fork of M.

LIMONIINÆ

LIMONIINI

LIMONIA (DICRANOMYIA) PACIFERA sp. nov. Plate 1, fig. 5; Plate 2, fig. 25.

Belongs to the *morio* group; size very small (wing, male, 4 millimeters or less); abdomen bicolorous, the segments brownish black basally, with narrower yellow caudal margins; male hypo-

pygium with the tergal lobes broad; apex of dorsal dististyle simple and acute; ventral dististyle compressed, mitten-shaped; mesal-apical lobe of gonapophysis short and stout.

Male.—Length, about 3.5 millimeters; wing, 3.8 to 4.

Female.—Length, about 4 to 5 millimeters; wing, 4 to 5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, strongly narrowed to short-petiolate at the distal end, the verticils considerably longer than the segments. Front and anterior vertex brilliant silvery white; posterior portions of head black; anterior vertex broad, exceeding three times the diameter of the scape.

Pronotum black, heavily light gray pruinose. Mesonotum polished black, the median area of scutum and base of scutellum weakly dusted. Pleura heavily dusted with gray, the sternopleurite polished black. Halteres with the stem obscure yellow, the knob black. Legs with the fore and middle coxæ black, posterior coxæ obscure yellow; trochanters yellow; femora brown, the fore pair darker, brownish black; tibiæ brown; tarsi passing into black. Wings (Plate 1, fig. 5) with a strong brownish tinge, the prearcular and costal portions somewhat more yellowish, best indicated by a brightening of the veins in these fields; stigma oval, darker brown than the ground; veins brown, except as above indicated. Venation: Sc_1 ending opposite or just before origin of Rs, Sc_2 far from its tip; free tip of Sc_2 opposite R_2, or as figured for the holotype specimen, lying a short distance proximad and with a short spur of R_{1+2} preserved; m-cu oblique, at or close to fork of M.

Abdomen chiefly bicolorous, yellow, the bases of the segments extensively brownish black, broader and more extensive on the intermediate segments; hypopygium of male and subterminal segments in female black. Male hypopygium (Plate 2, fig. 25) with the tergite, 9*t*, deeply emarginate, the lateral lobes broad, only a little narrower than the median notch; apices of lobes with long coarse setæ. Dorsal dististyle, *dd*, with the apex simple, acute. Ventral dististyle, *vd*, small, compressed, mitten-shaped, gradually narrowed to the apex; in the unique male, on slide mount, there appears to be a small peglike spine on outer margin before apex (as figured). Gonapophysis, *g*, with mesal-apical lobe blackened, short and stout.

Habitat.—China (Kwangtung, Kiangsi).

Holotype, male, Tsin-leong-san, Kwangtung, altitude 2,750 feet, June 6, 1936 (*Gressitt*). Allotype, female, Hong San, Kiangsi,

altitude 3,400 feet, June 29, 1936. Paratopotype, female, with the holotype, altitude 2,800 feet, June 5, 1936.

This fly is readily told from other described members of the *morio* group by the small size and structure of the male hypopygium, especially the broad tergal lobes, simple apex of the dorsal dististyle and short apical lobe of gonapophysis. As indicated, I am not entirely certain that a rostral spine is present; if so, it is much smaller than usual and lies far distad.

LIMONIA (DICRANOMYIA) DEPAUPERATA (Alexander).

Dicranomyia depauperata ALEXANDER, Entomological Magazine, Kyoto, Japan 3 (1919) 122.

Wide-spread in eastern Asia. Hong San, Kiangsi, altitude 5,000 feet, June 23, 1936 (*Gressitt*). In different specimens from various parts of the range of this fly there is some variation in the relative lengths of the rostral spines of the male hypopygium.

LIMONIA (DICRANOMYIA) SORDIDA (Brunetti).

Dicranomyia sordida BRUNETTI, Fauna Brit. India, Dipt. Nematocera (1912) 382–384.

Widely distributed in southern and eastern Asia. Males and females, Tsin-leong-san, Kwangtung, altitude 2,115 to 2,750 feet, June 3 and 4, 1936 (*Gressitt*). Hong San, Kiangsi, altitude 3,400 to 3,500 feet, June 29, 1936 (*Gressitt*).

LIMONIA (DICRANOMYIA) FULLAWAYI (Alexander).

Dicranomyia fullawayi ALEXANDER, Canad. Ent. 47 (1915) 79, 80.

Widely distributed in eastern Asia, as far west as Szechwan, western China. Males, Hong San, Kiangsi, altitude 2,500 feet, July 15, 1936 (*Gressitt*).

LIMONIA (DICRANOMYIA) RECTIDENS Alexander.

Limonia (*Dicranomyia*) *rectidens* ALEXANDER, Philip. Journ. Sci. 54 (1934) 323, 324.

Known hitherto only from western China. One male, Hong San, Kiangsi, altitude 2,750 feet, June 24, 1936 (*Gressitt*).

LIMONIA (THRYPTICOMYIA) UNISETOSA Alexander.

Thrypticomyia arcuata ALEXANDER, Trans. American Ent. Soc. 46 (1920) 4 (name preoccupied).

Limonia (*Thrypticomyia*) *unisetosa* ALEXANDER, Philip. Journ. Sci. 40 (1929) 248.

Widely distributed in Japan and Formosa. One male, Yimna-san, Kwangtung, altitude 1,800 feet, June 14, 1936 (*Gressitt*).

LIMONIA (EUGLOCHINA) DIGNITOSA Alexander.

Limonia (*Euglochina*) *dignitosa* ALEXANDER, Philip. Journ. Sci. **44** (1931) 351.

Known only from Szechwan, western China. One male, Tai-au-hong, Kiangsi, altitude 1,725 feet, July 6, 1936 (*Gressitt*). One female, Hong San, Kiangsi, altitude 3,500 feet, June 29, 1936 (*Gressitt*).

Differs from the type material chiefly in the shorter, more quadrate cell 1st M_2. In all specimens vein Cu_2 is well-preserved, approximately equal in length to vein Sc.

LIMONIA (ALEXANDRIARIA) ATAYAL Alexander.

Limonia (*Alexandriaria*) *atayal* ALEXANDER, Philip. Journ. Sci. **40** (1929) 529.

Described from Formosa. One female, Liung-chon-san, Fukien, altitude 2,550 feet, July 20, 1936 (Gressitt).

LIMONIA (RHIPIDIA) TRIARMATA Alexander.

Limonia (*Rhipidia*) *triarmata* ALEXANDER, Philip. Journ. Sci. **43** (1930) 514, 515.

Known from Formosa and western China. Males and females, Hong San, Kiangsi, altitude 3,400 feet, June 29, 1936 (*Gressitt*).

LIMONIA (GERANOMYIA) SPARSIGUTTATA sp. nov. Plate 1, fig. 6; Plate 2, fig. 26.

General coloration brown, the præscutum with three somewhat darker stripes; pleura yellow, with an ill-defined brown longitudinal stripe; wings weakly tinged with gray, sparsely patterned with brown, including very small spots at the supernumerary crossvein in cell Sc, origin of Rs and fork of Sc; larger clouds at stigma and tip of vein R_3; cell 1st M_2 subequal in length to longest vein beyond it; m-cu shortly before fork of M; male hypopygium with the rostral spines of ventral dististyle short, straight, arising from a common tubercle.

Male.—Length, excluding rostrum, about 4.3 millimeters; wing, 5; rostrum, 2.

Rostrum about one-half the length of body, brownish black. Antennæ with scape and pedicel black; flagellum broken. Head black; posterior vertex with a narrow median silvery vitta.

Pronotum yellow, darkened laterally. Mesonotal præscutum with a broad, central, medium brown stripe and less distinct lateral vittæ, these stripes faintly differentiated by very slightly darker posterior interspaces; median stripe narrower at anterior end than behind, on its cephalic margin with indications

of a capillary dark vitta; scutum testaceous medially, the lobes brown; scutellum brown, the caudal margin slightly yellow; a very delicate, median, dark vitta occupies the scutum and base of scutellum; postnotum darker brown, the mediotergite with a very sparse bloom. Pleura yellow, with an ill-defined brown longitudinal stripe extending from the cervical region to the base of abdomen, becoming wider on the pleurotergite. Halteres darkened, the base of stem yellow. Legs with the coxæ and trochanters yellow; remainder of legs brown, darker outwardly. Wings (Plate 1, fig. 6) with a weak grayish tinge, very sparsely patterned with pale brown, including the stigma; very small spots at the supernumerary crossvein in cell Sc, origin of Rs, fork of Sc, and tip of vein R_3; posterior cord and outer end of cell 1st M_2 very narrowly and insensibly seamed; veins pale brown. Venation: Sc long, Sc_1 ending only a short distance before outer end of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 long, equal to vein M_{1+2} beyond it; m-cu a short distance before fork of M.

Abdominal tergites dark brown; basal sternites light yellow. Male hypopygium (Plate 2, fig. 26) with the caudal margin of the tergite, 9*t*, gently emarginate. Ventral dististyle, *vd*, elongate, much more extensive than the basistyle, *b*; rostral prolongation unusually short and deep, with two short straight spines arising from a small common tubercle, one from the summit, the other near the base of tubercle. Gonapophysis, *g*, with mesal-apical lobe acute at tip, the lateral margin microscopically serrulate.

Habitat.—China (Fukien).

Holotype, male, Liung-chon-san, altitude 2,550 feet, July 21, 1936 (*Gressitt*).

Limonia (*Geranomyia*) *sparsiguttata* is most closely related to *L.* (*G.*) *kiangsiana* Alexander (northern Kiangsi, China), differing especially in the coloration of the body and wings and in the details of structure of the male hypopygium, as the beak of the rostral prolongation.

LIMONIA (GERANOMYIA) SPECTATA sp. nov. Plate 1, fig. 7.

General coloration of mesonotum plumbeous-gray, the posterior interspaces of præscutum and the scutal lobes with more blackish lines; femora dark brown, the bases and tips restrictedly paler; wings with a brown tinge, restrictedly patterned with darker brown, including a series of five costal areas; dark

spot at fork of Sc close to that at origin of Rs, the distance between the two not much greater than the diameter of either; Sc relatively short, Sc_1 ending nearly opposite midlength of Rs; cell 2d A of moderate width.

Female.—Length, excluding rostrum, about 7 millimeters; wing, 7; rostrum, about 2.8.

Rostrum black, relatively short. Antennæ black throughout; flagellar segments subglobular to short-oval, with inconspicuous verticils. Head blackish, variegated medially with gray.

Mesonotal præscutum almost uniform plumbeous-gray, with scarcely evident markings; in certain lights the posterior interspaces appear as slightly blackened lines, as in *atrostriata* and *kiangsiana*; scutum similarly plumbeous, each lobe with a linear black line near mesal edge and a shorter dark dash near lateral portion; posterior sclerites of notum dark plumbeous-gray, the ventral sclerites a little paler. Halteres with stem brownish yellow, the knob darker. Legs with the coxæ and trochanters obscure yellow; femora dark brown, the bases restrictedly obscure yellow, the tips narrowly and vaguely pale; tibiæ and tarsi brownish yellow, the outer tarsal segments darker. Wings (Plate 1, fig. 7) with a brownish tinge, restrictedly patterned with darker brown, as follows: Supernumerary crossvein in cell Sc; origin of Rs and fork of Sc; stigma and end of vein R_3; cord and outer end of cell 1st M_2 more narrowly seamed with brown; dark areas in costal cell more distinct than in *subradialis*, that at fork of Sc closer to Rs than to the stigma; veins pale brown, somewhat darker in the clouded areas. Venation: Sc relatively short, Sc_1 ending opposite or just beyond midlength of Rs; cell 1st M_2 about equal in length to vein M_{1+2} beyond it; m-cu at fork of M; cell 2d A of moderate width.

Abdomen dark brown, sparsely pruinose; caudal margins of the intermediate tergites vaguely paler.

Habitat.—China (Kwangtung).

Holotype, female, Tsin-leong-san, altitude 2,750 feet, June 3, 1936 (*Gressitt*).

The nearest allied species is *Limonia* (*Geranomyia*) *kiangsiana* Alexander (northern Kiangsi, China), which is generally similar in coloration of the body and wings, differing in the venation and arrangement of the dark costal areas, with the spot at fork of Sc lying farther distad, shortly before the outer end of Rs.

LIMONIA (GERANOMYIA) FREMIDA sp. nov.

General coloration of præscutum reddish, with three conspicuous brownish black stripes, the interspaces pale; head brownish black, the front and vertex with a narrow silvery median vitta; femora obscure yellow to brownish yellow; wings pale yellow, with brown areas, including about six costal markings; base of cell R darkened; conspicuous dark seams along cord and outer end of cell 1st M_2; m-cu at fork of M; cell 1st M_2 somewhat longer than vein M_{1+2} beyond it; abdomen with intermediate tergites brownish yellow, the outer segments darker.

Female.—Length, excluding rostrum, about 8 millimeters; wing, 7; rostrum, about 3.

Rostrum black, the divergent tips of the labial palpi short. Antennæ black, the scape brown, sparsely pruinose; flagellar segments oval to subcylindrical, with inconspicuous verticils. Head with front, anterior vertex, and a narrow median vitta on posterior vertex silvery, the remainder of posterior vertex brownish black.

Pronotum dark brown, the scutellum obscure yellow medially. Mesonotal præscutum with the ground color reddish, with three conspicuous brownish black stripes, the median one narrow and nearly obsolete in front, becoming obsolete before suture; interspaces of the ground color; scutal lobes brownish black, the remainder of scutum obscure reddish brown; scutellum reddish brown, darker medially at base; postnotum brownish black, heavily gray pruinose. Pleura chiefly obscure brownish yellow, the dorsal and posterior pleurites somewhat darker. Halteres with a weak tinge, the base of stem restrictedly pale. Legs with the coxæ and trochanters pale yellow; femora obscure yellow to brownish yellow; tibiæ and tarsi pale brown to darker brown, the outer segments of the latter black. Wings with the ground color pale yellow, rather heavily variegated with brown, as follows: about six costal and subcostal areas, the first near arculus in cell Sc and base of R; second at supernumerary crossvein in cell Sc, large and circular in outlines, reaching the costal vein in front and nearly to vein M behind; third area at origin of Rs, extending from vein C almost to vein M, somewhat wider behind; fourth area at fork of Sc; fifth area stigmal; sixth marking at end of vein R_3; broad dark seams along cord and outer end of cell 1st M_2; a small spot near basal third of cell R_3 immediately behind the stigma and a small interpolated

area in cell C between the second and third major costal darkenings; veins yellowish brown, darker in the clouded areas. Venation: Sc_1 ending about opposite three-fourths the length of Rs, Sc_2 at its tip; m-cu at fork of M; cell 1st M_2 somewhat longer than vein M_{1+2} beyond it.

Abdomen with the basal segment dark brown, the succeeding tergites brownish yellow, at near midlength of the organ passing into dark brown; basal sternites yellow, darker on sides; subterminal segments dark.

Habitat.—China (Kwangtung).

Holotype, female, Tsin-leong-san, altitude 2,750 feet, June 3, 1936 (*Gressitt*).

Limonia (*Geranomyia*) *fremida* somewhat resembles *L.* (*G.*) *subradialis* sp. nov., differing in the pattern of the wings and general coloration of the body. The wing pattern is much as in *L.* (*G.*) *spectata* sp. nov., but the coloration of the thorax is quite different. The darkening in the base of cell R is not found in the species listed above.

LIMONIA (GERANOMYIA) SUBRADIALIS sp. nov. Plate 1, fig. 8; Plate 2, fig. 27.

General coloration of præscutum reddish brown, with three brownish black stripes; head dark gray, with a median silvery gray stripe; knobs of halteres weakly darkened; legs yellow, the tips of femora and tibiæ narrowly darkened; wings yellowish gray, with a very restricted brown pattern, chiefly costal in distribution; Sc long, Sc_1 ending about opposite five-sixths the length of Rs; m-cu at fork of M; male hypopygium with the ninth tergite deeply notched medially; rostral prolongation of ventral dististyle compressed, at base laterally with two strong black spines from conspicuous basal tubercles; gonapophyses with mesal-apical lobe elongate.

Male.—Length, excluding rostrum, about 6 to 6.2 millimeters; wing, 6 to 6.3; rostrum, about 2.7 to 2.9.

Female.—Length, excluding rostrum, about 7 millimeters; wing, 6.9 to 7; rostrum, about 2.2 to 2.3.

Rostrum black throughout, shorter in female than in male, the recurved tips of the labial palpi short and inconspicuous in the female, somewhat longer in the male. Antennæ black throughout. Anterior vertex and a central vitta on posterior vertex narrowly silvery, the remainder dark gray.

Pronotum dark brown medially, paler on sides. Mesonotal præscutum reddish brown, with three brownish black stripes, the median one narrowed in front and not quite attaining the

cephalic portion of the sclerite; surface of præscutum weakly pruinose, especially behind; scutal lobes darkened, the median area dark but restrictedly pale on either side of the midline; scutellum dark brown medially at base, broadly brownish yellow on margin; postnotum heavily gray pruinose. Pleura chiefly obscure yellow, the surface more or less pruinose, especially on the pteropleurite and pleurotergite, the remainder less distinctly so; sternopleurite chiefly pale. Halteres pale, the knobs weakly darkened. Legs with the coxæ and trochanters pale; remainder of legs yellow, the femora and tibiæ with apices narrowly darkened; terminal tarsal segments black. Wings (Plate 1, fig. 8) yellowish gray, with a very restricted brown pattern, distributed as follows: At h; supernumerary crossvein in cell Sc; origin and fork of Rs; fork of Sc; stigma; tip of vein R_3, the areas much smaller than the interspaces; cord and outer end of cell 1st M_2 very narrowly seamed with brown; veins yellow, darker in the infuscated areas. Costal fringe of male relatively long and conspicuous, of female shorter. Venation: Sc long, Sc_1 ending opposite five-sixths the length of Rs, Sc_2 at its tip; cell 1st M_2 subequal to vein M_{1+2} beyond it; m-cu at fork of M.

Abdominal tergites and hypopygium brown, the basal sternites yellow. Male hypopygium (Plate 2, fig. 27) with the ninth tergite, 9*t*, deeply notched medially. Dorsal dististyle, *dd*, a nearly straight rod, the tip strongly curved. Ventral dististyle, *vd*, large and fleshy; rostral prolongation yellow, compressed, pendant; rostral spines placed on side of prolongation at base, each from a strong basal tubercle, the outer tubercle a little smaller. Gonapophyses, *g*, with mesal-apical lobe elongate.

Habitat.—China (Kwangtung).

Holotype, male, Tsin-leong-san, altitude 2,115 feet, June 2, 1936 (*Gressitt*). Allotopotype, female, altitude 2,750 feet, June 3, 1936. Paratopotypes, several of both sexes, altitude 2,700 to 2,800 feet, June 2 to 3, 1936.

Limonia (*Geranomyia*) *subradialis* is most nearly allied to *L.* (*G.*) *radialis* Alexander, differing most conspicuously in the very different male hypopygium, notably the gonapophyses.

LIMONIA (GERANOMYIA) TENUISPINOSA Alexander.

Limonia (*Geranomyia*) *tenuispinosa* ALEXANDER, Philip. Journ. Sci. 40 (1929) 329, 330.

Described from Chekiang Province, eastern China. Male, Yim-na-san, Kwangtung, altitude 2,115 feet, June 15, 1936 (*Gres-*

sitt). Female, Hong San, Kiangsi, altitude 2,750 feet, June 24, 1936 (*Gressitt*). Male, Liung-chon-san, Fukien, altitude 2,550 feet, July 21, 1936 (*Gressitt*).

LIMONIA (GERANOMYIA) APICIFASCIATA Alexander.

Limonia (*Geranomyia*) *apicifasciata* ALEXANDER, Philip. Journ. Sci. 43 (1930) 516, 517.

Described from Formosa. Males, Tsin-leong-san, Kwangtung, altitude 2,750 to 2,800 feet, June 3 and 4, 1936 (*Gressitt*).

LIMONIA (GERANOMYIA) GRACILISPINOSA sp. nov. Plate 1, fig. 9; Plate 2, fig. 28.

Size small (wing, male, 4.5 millimeters); general coloration plumbeous gray, the præscutum with three darker gray stripes; rostrum elongate, approximately one-half the remainder of body; knobs of halteres dark brown; legs brownish black, the femoral bases obscure yellow; wings subhyaline, the stigma oval, brown; Sc long, Sc_1 ending shortly before fork of Rs; cell 1st M_2 long, about equal to the longest vein beyond it; m-cu about one-third its length before fork of M; abdomen brownish black to black, the basal sternites yellow; male hypopygium with the rostral spines very long, arising from a long common tubercle, one placed at summit of tubercle, the other on the face at near three-fourths the length.

Male.—Length, excluding rostrum, about 4 millimeters; wing, 4.5; rostrum, about 2.

Rostrum elongate, black; tips of labial palpi long, curved; palpi black. Antennæ black throughout; flagellar segments oval, the outer ones not lengthened; terminal segment subequal to the penultimate, pointed at tip; verticils appressed, relatively short and inconspicuous. Head black, pruinose, compressed and distorted in the unique type.

Mesonotum dark plumbeous gray, the præscutum with three darker gray stripes, the scutal lobes with similarly darkened centers. Pleura gray pruinous. Halteres with stem yellow, knob dark brown. Legs with the fore coxæ black, sparsely pruinose; remaining coxæ and all trochanters yellow; remainder of legs brownish black, the femoral bases obscure yellow. Wings (Plate 1, fig. 9) subhyaline or very faintly tinged with darker, unmarked except for the oval brown stigma; cell Sc uniformly infumed; veins brown. Venation: Sc long, Sc_1 ending shortly before fork of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 nearly in transverse alignment; cell 1st M_2 long, about equal to the longest vein beyond it; m-cu about one-third its length before the fork of M.

Abdominal tergites brownish black to black; basal sternites yellow; outer segments, including hypopygium, uniformly darkened. Male hypopygium (Plate 2, fig. 28) with the caudal margin of the tergite, 9*t*, gently emarginate. Dorsal dististyle, *dd*, a slender, strongly curved rod, the tip acute. Ventral dististyle, *vd*, relatively long and narrow, its area much exceeding that of basistyle; rostral prolongation slender, before apex bearing a very long cylindrical tubercle that terminates in two long black spines, one arising from summit of tubercle, the other on face at near three-fourths the length. Gonapophyses, *g*, with the mesal-apical lobe long and slender, acute, the area of curvature bearing a pale flange.

Habitat.—China (Kwangtung).

Holotype, male. Tsin-leong-san, altitude 2,750 feet, June 4, 1936 (*Gressitt*).

Limonia (*Geranomyia*) *gracilispinosa* is very distinct from other species with unpatterned wings in the gray coloration of the body and especially in the very distinct structure of the male hypopygium. The latter organ is most generally similar to that of *L.* (*G.*) *apicifasciata* Alexander, which is otherwise an entirely different fly.

LIMONIA (GERANOMYIA) CONTRITA sp. nov. Plate 1, fig. 10.

General coloration dark brown, the præscutum with three confluent brown stripes, the lateral portions obscure yellow; wings uniformly tinged with brown, unmarked except for the oval darker brown stigma; Sc long, Sc_1 ending about opposite four-fifths the length of Rs; basal section of R_{4+5} short, not exceeding one-third the length of Rs; cell 2d A narrow; abdominal tergites dark brown.

Female.—Length, excluding rostrum, about 6 millimeters; wing, 6.2; rostrum, about 2.1.

Rostrum relatively short, black throughout. Antennæ black throughout; flagellar segments oval to subcylindrical, with inconspicuous verticils. Head with front, anterior vertex, and a median line on posterior vertex silvery, the remainder of vertex blackish, the sides more pruinose.

Pronotum conspicuously whitened. Mesonotal præscutum obscure yellow, chiefly covered by three confluent dark-brown stripes, the ground restricted to the broad humeral and lateral portions; posterior sclerites of notum darkened. Pleura chiefly pale, distorted in type. Halteres dusky. Legs with the coxæ and trochanters yellow; remainder of legs dark brown. Wings

(Plate 1, fig. 10) uniformly tinged with brown, unmarked except for the oval, darker brown stigma; veins dark brown. Venation: Sc long, Sc_1 ending about opposite four-fifths the length of Rs, Sc_2 at its tip; basal section of R_{4+5} short, not exceeding one-third Rs; cell 2nd A narrow.

Abdominal tergites dark brown, the basal sternites more yellowish.

Habitat.—China (Kwangtung).

Holotype, female, Tsin-leong-san, altitude 2,750 feet, June 6, 1936 (*Gressitt*).

The most similar regional species is *Limonia* (*Geranomyia*) *fletcheri* (Edwards), wide-spread in eastern and southern Asia. This latter fly has the coloration of the wings and body much the same but is entirely distinct in the venation, as the shorter Sc, ending at or near two-thirds the length of Rs; long basal section of vein R_{4+5}, which is one-half or more the length of Rs, and in the broad cell 2d A. The stigmal area in *fletcheri* is much smaller than in the present fly.

LIMONIA (LIMONIA) MACHIDAI (Alexander).

Dicranomyia machidai ALEXANDER, Ann. Ent. Soc. America 14 (1921) 113.

Limnobia pusilla LACKSCHEWITZ, Ann. Naturh. Mus. Wien 42 (1928) 232, 233.

Very widely distributed in temperate Eurasia. One male, Hong San, Kiangsi, altitude 2,800 feet, June 30, 1936 (*Gressitt*).

LIMONIA (LIBNOTES) HASSENANA Alexander.

Limonia (*Libnotes*) *hassenana* ALEXANDER, Philip. Journ. Sci. 43 (1930) 514.

Known hitherto only from Hassensan, Formosa, at moderate altitudes. Two females, Hong San, Kiangsi, altitude 2,750 to 5,100 feet, June 23 to 30, 1936 (*Gressitt*).

ANTOCHA (ANTOCHA) BIFIDA Alexander.

Antocha (*Antocha*) *bifida* ALEXANDER, Philip. Journ. Sci. 24 (1924) 564–566.

One of the most widely distributed of all known members of the genus, occurring throughout the major islands of Japan, in Formosa and in China as far west as Szechwan. To this date it had not been recorded from eastern China. Several specimens, Yim-na-san, Kwangtung, altitude 1,800 feet, June 11 to 14, 1936 (*Gressitt*).

HELIUS (HELIUS) HÆMORRHOIDALIS sp. nov. Plate 1, fig. 11; Plate 2, fig. 29.

General coloration reddish brown; rostrum about equal in length to remainder of head; antennæ short, black; head light gray, anterior vertex narrow; knobs of halteres orange; legs long and slender, femora brownish yellow; tibiæ and tarsi yellow; wings grayish subhyaline, the wing tip distinctly infumed; stigma oval, dark brown; branches of Rs divergent, cell R_2 at margin about one half as extensive as cell R_3; m-cu at or close to fork of M; abdominal tergites and hypopygium orange, sternites strikingly bicolorous, black, with about the distal third of the segments orange; male hypopygium with the outer dististyle bearing two erect spines on outer margin before apex to produce a tridentate appearance.

Male.—Length, about 6 to 6.5 millimeters; wing, 5 to 6.

Female.—Length, about 6.5 millimeters; wing, 6.

Rostrum piceous, subequal in length to remainder of head; palpi black. Antennæ short, only about as long as the head, black throughout; flagellar segments subglobular, the outer segments more elongate. Head light gray; anterior vertex in both sexes reduced to a linear strip that is only about one-half as wide as the diameter of the scape.

Pronotum brown medially, paler on sides. Mesonotum chiefly reddish brown, the præscutum darker medially. Pleura reddish, the sternopleurite and anepisternum more darkened. Halteres dusky, the knobs orange. Legs with the coxæ reddish brown; trochanters obscure yellow; remainder of legs long and slender; femora brownish yellow, a little darker outwardly; tibiæ and tarsi yellow. Wings (Plate 1, fig. 11) grayish subhyaline, the tip distinctly infumed; stigma oval, dark brown; prearcular and costal regions clearer yellow; veins brown, more luteous in the yellow portions. Costal fringe relatively short. Venation: Sc long, Sc_1 ending a short distance before outer end of Rs, Sc_2 near its tip; branches of Rs divergent, cell R_2 at margin only about one-half as extensive as cell R_3; m-cu at or shortly beyond fork of M.

Abdominal tergites and hypopygium orange; sternites strikingly bicolored, black, with about the distal third of the individual segments abruptly orange. Male hypopygium (Plate 2, fig. 29) with the basistyle, *b*, unmodified. Outer dististyle, *od*, relatively short and stout, at apex produced into a decurved spine; before tip on outer margin with two erect spines or

with a single strongly bifid one. Inner dististyle, *id*, longer, moderately dilated at base. Gonapophyses, *g*, appearing as very flattened compressed plates, the tips broadly obtuse. Ovipositor with elongate valves.

Habitat.—China (Kiangsi, Fukien).

Holotype, male, Tai-au-hong, Kiangsi, altitude 1,720 feet, July 4, 1936 (*Gressitt*). Allotopotype, female, July 6, 1936, pinned with broken male paratopotype. Paratypes, male, Gang-keu, Fukien, altitude 1,900 feet, July 24, 1936; male, Wong-sa-shue, Kiangsi, altitude 1,750 feet, July 9, 1936 (*Gressitt*).

This very distinct species somewhat resembles *Helius* (*Helius*) *anæmicus* Alexander, but is very different from all species hitherto described. The coloration of the abdominal sternites and the structure of the outer dististyle of the male hypopygium are distinctive features.

HELIUS (HELIUS) ACIFERUS sp. nov. Plate 1, fig. 12; Plate 2, fig. 30.

General coloration of mesonotal præscutum reddish brown, with a darker brown median stripe; antennæ (male) elongate, nearly as long as the body; posterior sclerites of mesonotum and the pleura darkened; knobs of halteres dark brown; wings tinged with dusky, stigma dark brown; small darkened clouds at origin of Rs and along cord; male hypopygium with the basistyle bearing two lobes on mesal face; outer dististyle a blackened rod, at apex produced into a simple acute point.

Male.—Length, about 5 to 5.5 millimeters; wing, 5 to 5.8; antenna, about 5.

Female.—Length, about 7 to 7.5 millimeters; wing, 6 to 6.2.

Rostrum black, about equal in length to remainder of head; palpi black. Antennæ (male) unusually elongate, nearly as long as the entire body, black throughout; flagellar segments long-cylindrical, with a dense erect pubescence. Head dark gray; anterior vertex narrow.

Pronotum dark brown. Mesonotal præscutum reddish brown with a darker brown median stripe; lateral stripes only feebly indicated; posterior sclerites of notum brownish black to black, the median scutal area a little brightened. Pleura extensively dark brown to brownish black. Halteres with the stem yellow, the knob dark brown. Legs with the fore coxæ darkened, the remaining coxæ testaceous to yellow; trochanters yellow; remainder of legs yellow. Wings (Plate 1, fig. 12) relatively narrow, tinged with dusky; stigma oval, relatively dark brown; a small dark cloud at origin of Rs and a similarly darkened

seam along cord; veins brown. Venation: Sc long, Sc_1 ending nearly opposite fork of Rs, Sc_2 at its tip; Rs relatively elongate, in cases angulated and short-spurred at origin; anterior branch of Rs long, only feebly diverging from the posterior branch; cell R_2 at margin more extensive than cell R_3; m-cu variable in position, from opposite the fork of M to about one-half its length beyond this fork.

Abdomen dark brown, the sternites concolorous or somewhat paler yellowish brown, the segments unicolorous. Male hypopygium (Plate 2, fig. 30) with the basistyle, *b*, complicated by outgrowths on mesal face, including a slender lobe tufted with long setæ placed at near midlength of style and a stouter, more distal lobe that terminates in a few short spines. Outer dististyle, *od*, blackened, gently curved, gradually narrowed to the simple acute point. Inner dististyle, *id*, pale, broad at base, the lower margin with several strong setæ. Ovipositor with elongate valves.

Habitat.—China (Kiangsi).

Holotype, male, Tai-au-hong, altitude 1,700 feet, July 5, 1936 (*Gressitt*). Allotype, female, Hong San, altitude 3,400 feet, June 29, 1936. Paratypes, one male, two females, with the allotype, altitude 2,725 to 3,400 feet, June 29 to 30, 1936 (*Gressitt*).

The nearest allied regional species is *Helius* (*Helius*) *obliteratus* Alexander, of Japan, which has similarly elongate antennæ in the male sex and with the wing venation and pattern approximately the same but which differs very conspicuously in the structure of the male hypopygium.

ORIMARGA (ORIMARGA) EXASPERATA sp. nov. Plate 1, fig. 13; Plate 2, fig. 31.

General coloration blackish, sparsely pruinose; halteres dusky; legs black; wings very broad, slightly tinged with dusky, the short prearcular area whitish; sparse macrotrichia on outer ends of veins R_3, R_{4+5}, M_{1+2}, and M_3; free tip of Sc_2 lacking; R_{2+3} short, subequal in length to R_2; cephalic end of m-cu just beyond midlength of Rs; vein 2d A elongate; male hypopygium with the phallosome broad, its apex without spinous points.

Male.—Length, about 6.5 millimeters; wing, 5.

Rostrum black, sparsely pruinose; palpi black. Antennæ black throughout; flagellar segments oval; verticils inconspicuous. Head blackish gray.

Mesonotum blackish, with a sparse gray pruinosity, the præscutum with three poorly defined still darker stripes. Pleura black, sparsely pruinose. Halteres dusky. Legs with the coxæ

and trochanters brownish black to dark brown; remainder of legs black, the femoral bases a trifle paler. Wings (Plate 1, fig. 13) very broad, with a slight dusky tinge, the short prearcular area whitish; veins brown. Costal fringe of moderate length; outer portion of costal vein incrassated. Macrotrichia of veins beyond cord restricted, there being a loose series of about eight on R_3, and from ten to twelve on outer ends of veins R_{4+5}, M_{1+2}, and M_3, these latter chiefly arranged in pairs. Venation: Free tip of Sc_2 lacking; R_{2+3} short subequal to R_2; basal section of R_{4+5} strongly angulated before midlength; cephalic end of m-cu just beyond midlength of Rs; vein 2d A elongate.

Abdomen black, the sternites a trifle paler; hypopygium somewhat brightened. Male hypopygium (Plate 2, fig. 31) with the outer dististyle, *od,* unusually stout, at tip suddenly narrowed into a short point. Inner dististyle, *id,* before apex bent into a right angle, the apex slender. Interbase a slender, pale, straight rod. Phallosome, *p,* broad, at apex without conspicuous spinous points as found in *gymnoneura.*

Habitat.—China (Kwangtung).

Holotype, male, Tsin-leong-san, altitude 2,750 feet, June 5, 1936 (*Gressitt*).

Orimarga (*Orimarga*) *exasperata* is most similar to *O.* (*O.*) *gymnoneura* Alexander, of Formosa, agreeing in the general coloration of the body, legs and wings, and in the conformation of the wings, including the short prearcular field. It differs in the details of venation, especially of the radial field, the more abundant trichia of the outer wing veins, and especially in the structure of the male hypopygium. In *O.* (*O.*) *gymnoneura,* just before the apex of the phallosome, there is a group of several sharp spines that are not present in the insect here discussed.

HEXATOMINI

PSEUDOLIMNOPHILA PROJECTA sp. nov. Plate 1, fig. 14.

General coloration medium brown; antennæ black, the outer flagellar segments elongate and provided with long verticils; wings with a uniform pale brown tinge; R_2 before fork of R_{3+4}; cell M_1 lacking; veins issuing from cell 1st M_2 relatively short; anterior arculus preserved.

Male.—Length, about 4.6 millimeters; wing, 5.4.

Rostrum light yellow; palpi black. Antennæ black throughout, relatively long and slender; outer flagellar segments becoming long-cylindrical, with conspicuous verticils; basal fla-

gellar segments with verticils short and inconspicuous. Head dark brown.

Mesonotum almost uniformly medium brown, the scutellum a trifle more testaceous; mediotergite with central portion darkened, the broad lateral margins more brownish yellow. Pleura brownish yellow. Halteres infuscated. Legs with the coxæ and trochanters testaceous yellow; remainder of legs brown, the outer tarsal segments passing into dark brown. Wings (Plate 1, fig. 14) with a uniform pale brown tinge; stigma small, pale brown, scarcely darker than the ground color; veins brown. Costal fringe (male) of moderate length, dense. Venation: Sc of moderate length, Sc_1 ending about opposite four-fifths the length of Rs; R_{2+3+4} rather strongly arcuated; R_2 before the fork of R_{3+4}, the distance somewhat variable in the type specimen, longest in the right wing, as figured; veins issuing from cell 1st M_2 relatively short, the longest not twice the length of the cell; cell M_1 lacking; anterior arculus preserved.

Abdominal tergites dark brown, the sternites more yellowish brown, their caudal margins narrowly yellow; hypopygium chiefly pale brownish yellow.

Habitat.—China (Kwangtung).

Holotype, male, Mei-hsien, altitude 715 feet, July 18, 1936 (*Gressitt*).

Pseudolimnophila projecta is readily told from allied regional species, such as *P. descripta* Alexander (Formosa) by the venation, as the short cell R_3 and the length of the veins beyond cell 1st M_2. In the present fly, Sc is shorter and Rs shorter and more arcuated than in allied forms in which cell M_1 is lacking.

HEXATOMA (ERIOCERA) QUADRIATRATA sp. nov. Plate 1, fig. 15.

Belongs to the *rubrescens* group; general coloration of body dark plumbeous-gray, the sides of præscutum and scutum with velvety black areas; trochanters and femora light yellow, the remainder of legs a trifle darker; wings with a strong brown suffusion, the prearcular and costal regions more saturated; stigma small, dark brown; R_{1+2} and R_2 subequal; R_{2+3+4} and R_{2+3} in longitudinal alignment and subequal, more than twice as long as the basal section of R_5; cell M_1 about twice its petiole; m-cu at or before midlength of cell 1st M_2.

Female.—Length, about 15 to 16 millimeters; wing, 13 to 13.5.

Rostrum black, sparsely pruinose; palpi black. Antennæ black throughout, 8-segmented (female); flagellar segments

cylindrical, with abundant setæ, those of basal two flagellar segments chiefly unilateral in distribution. Head dark gray; anterior vertex relatively narrow, the low simple tubercle correspondingly narrowed; setæ of head relatively sparse, on posterior portion shortened and reduced in number.

Mesonotum almost uniformly dark plumbeous-gray, the lateral margin of præscutum before suture and of the scutal lobes behind the suture extensively velvety black; mesonotum glabrous. Pleura dark plumbeous-gray; dorsopleural membrane dusky. Halteres dark brown, the extreme base of stem brightened. Legs with the coxæ brownish black; trochanters and femora light yellow; tibiæ and tarsi a trifle more brownish yellow. Wings (Plate 1, fig. 15) with a strong brown suffusion, the prearcular and costal portions more saturated brown; cell Sc a little more yellowish, especially on proximal portion; stigma small and narrow, dark brown; vague, scarcely evident, dark seams along cord and outer end of cell 1st M_2; veins darker brown than the ground. Longitudinal veins beyond cord with abundant macrotrichia. Venation: Sc_1 ending nearly opposite fork of R_{2+3+4}; R_{1+2} and R_2 subequal; R_{2+3+4} and R_{2+3} in longitudinal alignment and subequal in length, either more than twice as long as basal section of R_5; cell M_1 deep, from one and one-half to two times its petiole; m-cu at or just before midlength of cell 1st M_2.

Abdomen dark plumbeous; dorsal shield of ovipositor deep reddish brown; cerci moderately long, basal half darkened, distal portion more slender, gently upcurved, yellow.

Habitat.—China (Kiangsi).

Holotype, female, Tai-au-hong, altitude 1,725 feet, July 6, 1936 (*Gressitt*). Paratopotype, female, Wong-sa-shue, altitude 1,750 feet, July 9, 1936.

The present fly differs rather conspicuously from other members of the *rubrescens* group in the coloration of the body, wings, and legs, as well as in the details of venation. By Edwards's key to the Old World species of the subgenus [2] the fly runs to couplet 29 where it can be traced no further, in having the combination of five posterior cells and being equipped with velvety black spots on the sides of the mesonotum.

[2] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

HEXATOMA (ERIOCERA) DAVIDI (Alexander).

Eriocera davidi ALEXANDER, Bull. Mus. Hist. Nat. Paris 1922 (1922) 295, 296.

One male, Tai-au-hong, Kiangsi, altitude 1,725 feet, July 6, 1936 (*Gressitt*). This specimen has the white discal area of wings much reduced, being narrow and involving cells R, M, and posterior edge of R_1; besides the primary white area, there are several small pale dashes on either side of this fascia. Antennæ (male) 8-segmented; claws toothed.

HEXATOMA (ERIOCERA) OBLIQUA (Alexander).

Eriocera obliqua ALEXANDER, Proc. Hawaiian Ent. Soc. 5 (1923) 255, 256.

Known hitherto only from Macao. One female, Hong San, Kiangsi, altitude 2,500 feet, July 15, 1936 (*Gressitt*). The present specimen agrees closely with the type except that the ground color of the wings is more intensely black and unfaded; Rs a little shorter; basal section of R_5 about one-half longer than R_{2+3+4}; Sc a little longer, Sc_1 ending shortly beyond level of fork of R_{2+3+4}. Antennæ (female) 11-segmented; claws simple.

HEXATOMA (ERIOCERA) CHRYSOMELA (Edwards).

Eriocera chrysomela EDWARDS, Ann. & Mag. Nat. Hist. IX 8 (1921) 88, 89.

Described from Hong Kong, China. One female, Hong San, Kiangsi, altitude 1,425 feet, July 10, 1936 (*Gressitt*). One female, Liung-chon-san, Fukien, altitude 2,540 feet, July 21, 1936 (*Gressitt*).

ERIOPTERINI

TEUCHOLABIS (TEUCHOLABIS) KIANGSIENSIS sp. nov. Plate 1, fig. 16.

Female.—Length, about 7.5 to 8 millimeters; wing, 5.5 to 6.

Most closely allied to *T.* (*T.*) *iriomotensis* Alexander, of the southern Loochoo Islands, differing especially in the patterned wings. The fly differs from *iriomotensis* in the following regards:

Posterior portion of head not pruinose. Median region of præscutum before suture extensively yellow. Sternopleurite not or scarcely darkened. Legs with the tibiæ yellowish brown, narrowly blackened at either end. Wings (Plate 1, fig. 16) distinctly patterned; whitish subhyaline, with brown areas arranged as follows: Cell Sc; a small spot at origin of Rs; stigma

and a broad confluent seam along cord; outer end of cell 1st M_2 similarly seamed; small marginal clouds at end of anterior branch of Rs and of 2d A. Venation: Sc_2 more removed from tip of Sc_1, placed nearer the origin of Rs than to the tip of Sc_1. Ovipositor with bases of cerci blackened, only the tips dark horn-colored.

Habitat.—China (Kiangsi).

Holotype, female, Hong San, altitude 2,750 feet, June 24, 1936 (*Gressitt*). Paratopotypes, females, altitude 3,150 feet, June 27, 1936.

GYMNASTES (GYMNASTES) SHIRAKII (Alexander).

Paratropeza (*Gymnastes*) *shirakii* ALEXANDER, Ann. Ent. Soc. America 13 (1920) 254.

Described from high altitudes in Formosa. Additional records: Formosa: Urai, April 20, 1922 (*K. Takeuchi*). Southeastern China: Hong San, Kiangsi, altitude 2,750 to 3,500 feet, June 25 to 30, 1936 (*Gressitt*), several specimens.

GONOMYIA (LIPOPHLEPS) INQUISITA sp. nov. Plate 1, fig. 17.

Belongs to the *nubeculosa* group; general coloration dark brown, pruinose; knobs of halteres dark brown; femora brownish yellow, with a broad, brownish black, subterminal ring, preceded and followed by narrow yellowish annuli; wings strongly darkened, variegated by china white and darker brown areas; cells R and M uniformly infumed; Sc_1 and Sc_2 both beyond origin of Rs; vein R_4 short, about one-half as long as R_{2+3+4}; cell 1st M_2 subequal to vein M_3 beyond it; abdomen brownish black, the segments narrowly ringed caudally with whitish.

Female.—Length, about 5.8 millimeters; wing, 4.2.

Rostrum and palpi black. Antennæ with the scape and pedicel brown on ventral faces, yellow above; flagellum dark brown; flagellar segments with a dense erect white pubescence. Head yellow, the center of the vertex darkened.

Pronotum and lateral pretergites very pale yellow. Mesonotum brownish gray, the posterior margin of scutellum broadly pale yellow. Pleura dark brown, with a conspicuous, white, longitudinal stripe extending from and including the fore coxæ, passing above the remaining coxæ to base of abdomen; dorsopleural region chiefly yellow. Halteres with stem yellowish white, the knob chiefly dark brown. Legs with the fore coxæ as described above, its extreme base darkened; remaining coxæ brown; trochanters yellow; femora yellow, slightly more brown-

ish yellow outwardly, with a broad brownish black subterminal ring, preceded and followed by narrower yellow rings, each of the latter about one-half as wide as the darkened annulus; tibiæ and basitarsi yellow, outer tarsal segments black. Wings (Plate 1, fig. 17) with the ground color strongly darkened, variegated by china white and darker brown areas; the white includes the prearcular and costal regions, together with the wing tip; cells R and M uniformly of the ground color; dark-brown areas small, at arculus, origin of Rs, stigma, and along cord; more restricted darkenings at tips of veins R_3, R_4, R_5, M_3, M_4 and Cu_1; veins brown, paler in the whitened areas, darker along the cord. Costal fringe unusually long and conspicuous for the female sex. Venation: Sc relatively long, both Sc_1 and Sc_2 lying beyond origin of Rs; R_3 short and erect, about two-thirds as long as m; R_4 short, about one-half the length of R_{2+3+4}; cell 1st M_2 subequal to vein M_3 beyond it.

Abdomen brownish black, the segments narrowly ringed caudally with whitish, a little more conspicuously so on the tergites. Ovipositor with the basal shield obscure yellow, narrowly darkened at base.

Habitat.—China (Kiangsi).

Holotype, female Wong-sa-shue, altitude 1,750 feet, July 8, 1936 (*Gressitt*).

Related to *Gonomyia* (*Lipophleps*) *conquisita* Alexander, *G.* (*L.*) *nubeculosa* de Meijere, and *G.* (*L.*) *pallidisignata* Alexander. The various members of the group are separated in the female sex by characters of wing pattern and venation, as to whether the basal cells are variegated on their proximal portions, as in *pallidisignata;* by venation, especially the length of Sc, the relative proportions of veins R_{2+3+4} and R_4, and the length of cell 1st M_2, proportional to vein M_3 beyond it. The leg pattern, especially the coloration and width of the darkened femoral rings, furnish important characters; in *conquisita,* this dark annulus is pale and narrow. The present fly differs from the others in the longer Sc, which projects distinctly beyond the origin of Rs.

GONOMYIA (LIPOPHLEPS) SUBANXIA sp. nov. Plate 1, fig. 18; Plate 2, fig. 32.

Belongs to the *skusei* group; general coloration of mesonotum dark brown, the posterior margin of scutellum broadly yellow; head gray; pleurotergite and metapleura chiefly yellowish white; halteres and legs darkened; wings broad, tinged with

dusky, the stigma a little darker; Sc_1 ending beyond midlength of Rs; abdominal tergites dark brown; male hypopygium with the dististyle fleshy; phallosome pale, the apex of ædeagus subacute.

Male.—Length, about 3.8 to 4 millimeters; wing, 3.8 to 4.

Rostrum yellow; palpi black. Antennæ black; flagellar segments cylindrical, with an abundant erect pubescence. Head gray.

Pronotum and anterior lateral pretergites light yellow. Mesonotal præscutum and scutal lobes almost uniformly dark brown, the surface very sparsely pruinose; median area of scutum in front and posterior lateral portions of scutal lobes yellow; scutellum darkened medially at base, the posterior margin broadly obscure yellow; mediotergite brownish black, the anterior lateral margins restrictedly yellow. Pleura chiefly dark brown, the dorsopleural region yellow; pleurotergite and metapleura chiefly pale yellowish white. Halteres dark brown, the extreme base of stem pale, the knob a trifle brightened. Legs brownish black throughout. Wings (Plate 1, fig. 18) broad, with a strong dusky tinge, the elongate stigmal area a little darker; prearcular and costal regions more whitish; veins brown. Venation: Sc long, Sc_1 extending to beyond midlength of Rs, Sc_2 a short distance from its tip; branches of Rs long, the anterior one paralleling R_1 for most of its length; m-cu just before fork of M.

Abdomen dark brown, the sternites and hypopygium a trifle brighter. Male hypopygium (Plate 2, fig. 32) with the outer lobe of basistyle, *b*, slender; a single dististyle, *d*, fleshy, nearly equal in size and shape to the lobe of the basistyle. Phallosome, *p*, complex, without heavily sclerotized or blackened points, the apex of ædeagus subacute, gradually narrowed to the tip.

Habitat.—China (Kwangtung).

Holotype, male, Yim-na-san, altitude 2,115 feet, June 15, 1936 (*Gressitt*). Paratopotype, male. Paratype, male, Mei-hsien, altitude 715 feet, May 31, 1936 (*Gressitt*).

The nearest ally is *Gonomyia* (*Lipophleps*) *anxia* Alexander, of western Sumatra, which has the hypopygium of this same general structure. In the latter species the wings are conspicuously narrower, Sc shorter and the apex of the ædeagus very narrow, a slender falcate blade. There are several species of the *skusei* group in the Philippines but all of these are more distantly allied. In Japan, Formosa, and China, only a single additional species, *G.* (*L.*) *sauteri* Alexander, has been described

to this date, and this is entirely distinct from the present fly in the structure of the male hypopygium.

GONOMYIA (LIPOPHLEPS) ATROX sp. nov. Plate 1, fig. 19; Plate 3, fig. 33.

General coloration blackish gray; head yellow, the central portion of posterior vertex brownish black; pleura black, with a longitudinal yellowish white stripe; knobs of halteres extensively darkened; femora yellow, with a broad brownish black subterminal annulus, preceded and followed by narrow, light yellow rings; wings clouded with brown and pale, the costal border yellow; Sc short; male hypopygium with the outer dististyle a powerful black rod, at base on mesal face with two long, strongly curved, black hooks.

Male.—Length, about 3 millimeters; wing, 3.2.

Rostrum and palpi black. Antennæ with the scape and pedicel black on lower or ventral face, yellow above; flagellum black, the basal segment brightened. Head light yellow, the central portion of posterior vertex extensively brownish black; postgenæ infuscated.

Pronotum and anterior lateral pretergites light yellow. Mesonotum black, sparsely gray pruinose; scutellum with posterior border obscure yellow. Pleura black, with a relatively narrow, yellowish white, longitudinal stripe, extending from fore coxæ to base of abdomen; dorsal pleurotergite and pteropleurite yellowish brown. Halteres yellow, the knobs extensively darkened. Legs with the fore coxæ obscure yellow, remaining coxæ testaceous brown; trochanters obscure yellow; femora brownish yellow with a broad dark brown or brownish black subterminal annulus, preceded and followed by much narrower, clear yellow rings, the latter at the tip of the segment; tibiæ yellow, the extreme base and tip darkened; tarsi brownish yellow, passing into black. Wings (Plate 1, fig. 19) with the ground color brown, variegated by clearer areas, chiefly before and beyond stigma, before cord and as smaller markings in certain of the other cells; costal border of wing narrowly light yellow; veins pale brown, a little darker in the clouded areas. Venation: Sc relatively short, the distance on costa between Sc_1 and origin of Rs only a little less than the length of the latter; m-cu at fork of M.

Abdomen brownish black, the incisures of the segments pale; hypopygium dark. Male hypopygium (Plate 3, fig. 33) with the outer dististyle, *od*, a powerful black rod, nearly straight, at base on mesal face with two long, strongly curved, black

hooks; mesal face of style at near one-third the length with an acute erect spine; beyond this point the style slightly constricted and the mesal face microscopically roughened. Inner dististyle a small simple lobe, pointed at outer end, provided with long setæ, at apex with two long pale fasciculate bristles. Phallosome, *p*, complex, consisting of a broadly depressed plate, the caudal margin terminating in four short black spinous points, the outer pair from cylindrical lobes. Distad of the phallosome, as figured, lie other massive structures and a strongly curved crook, the end of which is shown.

Habitat.—China (Kiangsi).

Holotype, male, Hong San, altitude 3,000 feet, June 26, 1936 (*Gressitt*).

Gonomyia (*Lipophleps*) *atrox* is very distinct from allied regional forms in the structure of the male hypopygium, which is very different from all other species known to me.

IDIOCERA (IDIOCERA) TERANISHII (Alexander).

Gonomyia (*Ptilostena*) *teranishii* ALEXANDER, Ann. Ent. Soc. America 14 (1921) 118, 119.

Described from Morioka, Honshiu, Japan. The following Chinese records are now available:

Hang-chow, Chekiang, April 28, 1924 (*Suenson*); Liung-chon-san, Fukien, altitude 2,550 feet, July 20, 1936 (*Gressitt*); Mount Omei, Szechwan, altitude 4,000 feet, July 14, 1931 (*Franck*); Boat on the Min River, Szechwan, April 30, 1933 (*Franck*).

It should be noted that the subgeneric name *Idiocera* has been retained for those species of *Gonomyia* in which the anterior arculus of the wings is entire.

IDIOCERA (PTILOSTENODES) UNIPLAGIATA sp. nov. Plate 1, fig. 20; Plate 3, fig. 34.

Small (wing 4 millimeters or less); posterior vertex polished black; mesonotum black, variegated with yellow on the scutum and scutellum; mediotergite yellow medially, the sides darkened; pleura yellow, with a single major black area on anepisternum; halteres black; legs dark brown to brownish black, the femoral bases narrowly obscure yellow; wings subhyaline, m-cu at or close to fork of M; abdominal tergites black, sternites yellow to brownish yellow.

Male.—Length, about 3.2 to 3.3 millimeters; wing, 3.7 to 3.8.

Female.—Length, about 4 millimeters; wing, 4.

Rostrum yellow; outer palpal segments infuscated. Antennæ with scape obscure yellow; pedicel and flagellum black; flagellar

segments oval, the longest verticils a little exceeding the segments. Head with the front and orbits yellow; anterior vertex infuscated; posterior vertex and occiput polished black.

Pronotum yellow, narrowly infuscated medially. Mesonotal præscutum chiefly covered by a polished black discal area, the humeral region restrictedly pale; scutum polished black on the lobes and across the median area, leaving obscure yellow areas behind the suture and along the posterior borders of the lobes; scutellum black medially, obscure yellow on posterior portion, parascutella black; mediotergite with central portion yellow, the sides darkened; pleurotergite darkened, especially behind. Pleura obscure yellow, with a major black area occupying the anepisternum. Halteres black. Legs with the coxæ obscure yellow, the fore coxæ a trifle darkened; trochanters yellow; remainder of legs dark brown or brownish black, the femoral bases narrowly obscure yellow, somewhat more extensively so on the fore pair; posterior femora slightly paler in color than the middle or fore pairs. Wings (Plate 1, fig. 20) subhyaline or with a faint gray tinge; veins slender, brown. Macrotrichia on all veins beyond cord, on anterior branch of Rs restricted to a central series of about ten, on the distal section of Cu_1 occurring on outer half of vein. Venation: Sc_1 ending opposite or just before origin of Rs, Sc_2 at midlength of the distance between arculus and origin of Rs; anterior branch of Rs bent strongly cephalad at anterior end so cell R_4 at margin is considerably wider than cell R_2; m-cu at or immediately before fork of M.

Abdominal tergites black; sternites yellow to brownish yellow; hypopygium yellow. Male hypopygium (Plate 3, fig. 34) with three dististyles; median style, *md*, bifid, with glabrous blades, the stem with abundant setæ; inner style, *id*, a flattened spatulate blade, with coarse setæ. Ædeagus gradually narrowed outwardly, terminating in a slender apical point.

Habitat.—China (Kiangsi).

Holotype, male, Tai-au-hong, altitude 1,700 feet, July 5, 1936 (*Gressitt*). Allotopotype, female. Paratopotype, male.

Idiocera (*Ptilostenodes*) *uniplagiata* is readily told from the other described species of the subgenus by the position of m-cu at or very close to the fork of M. The fly is more generally similar to the Philippine *I.* (*P.*) *ptilostenella* (Alexander) than to the Formosan and western Chinese species.

GNOPHOMYIA (GNOPHOMYIA) DEJECTA Alexander.

Gnophomyia dejecta ALEXANDER, Philip. Journ. Sci. 40 (1929) 542, 543.

Known from various stations in Formosa. Male, Hong San, Kiangsi, altitude 3,000 feet, June 25, 1936 (*Gressitt*). Both sexes, Liung-chon-san, Fukien, altitude 2,550 feet, July 20 and 21, 1936 (*Gressitt*).

CRYPTOLABIS (BÆOURA) ANGUSTILOBATA sp. nov. Plate 1, fig. 21; Plate 3, fig. 35.

Belongs to the *trichopoda* group; general coloration black; head dark gray; wings with a weak brown tinge, the costal region more whitened; femora brownish yellow, the tips narrowly darkened; legs with long conspicuous erect setæ; male hypopygium with the tergite broad, each lateral angle produced caudad into a narrow glabrous lobe, the caudal margin between these lobes truncated.

Male.—Length, about 3.8 to 4 millimeters; wing, 4.6 to 5.

Female.—Length, about 4 millimeters; wing, 5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments passing through oval into long-oval and cylindrical, with elongate verticils. Head dark gray.

Pronotum and mesonotum black, the anterior lateral pretergites very restrictedly and vaguely brightened; posterior margin of scutellum a trifle paler. Pleura black, sparsely pruinose, especially on posterior sclerites. Halteres brownish black, the base of stem restrictedly brightened. Legs with the coxæ and trochanters dark brown; remainder of legs brownish yellow, the tips of the femora and tibiæ narrowly darkened; terminal tarsal segments infuscated; legs with long, conspicuous, erect setæ. Wings (Plate 1, fig. 21) with a weak brown tinge, the costal region more whitened; stigma small and poorly indicated; veins and macrotrichia dark. Venation: Petiole of cell M_3 a little longer than m-cu; cell 2d A relatively narrow.

Abdomen, including hypopygium and ovipositor, dark brown. Male hypopygium (Plate 3, fig. 35) with the tergite, 9*t*, broad, each lateral angle produced caudad into a narrow glabrous lobe, its tip obtuse, the caudal margin between these lobes truncated. Dististyle, *d*, relatively narrow, gently curved to the subacute tip; before apex on lower margin with about two small spines. What is here interpreted as being modified gonapophyses terminate in a semicircular pale lobe that is provided with four or five conspicuous setæ. Eighth sternite, 8*s*, with apex darkened and slightly produced into an obtuse lobe.

Habitat.—China (Kwangtung).

Holotype, male, Yim-na-san, altitude 1,800 feet, June 11, 1936 (*Gressitt*). Allotopotype, female, with the type. Paratopotypes, one male, one female, June 10 to 14, 1936.

Cryptolabis (*Bæoura*) *angustilobata* is readily told from all regional allied species, as *C.* (*B.*) *trichopoda* Alexander (Formosa), *C.* (*B.*) *lævilobata* Alexander (Formosa), *C.* (*B.*) *setosipes* Alexander (Hainan), and *C.* (*B.*) *consona* Alexander (Hainan), by the structure of the male hypopygium, especially of the tergite, dististyle, and gonapophyses.

MOLOPHILUS INJUSTUS sp. nov. Plate 1, fig. 22; Plate 3, fig. 36.

Belongs to the *gracilis* group, *assamensis* subgroup; general coloration dark brownish gray; antennæ (male) elongate, nodulose; halteres with dark-brown knobs; femora chiefly dark brown, the bases narrowly obscure yellow, the posterior femora chiefly yellow with about the distal third darkened; wings with a weak dusky tinge; R_{2+3} longer than R_{4+5}; male hypopygium with the dorsal lobe of basistyle exceeding the dististyle in length, provided with long coarse setæ; inner dististyle entirely darkened.

Male.—Length, about 3.5 millimeters; wing, 4; antenna, about 3.2.

Rostrum gray; palpi black. Antennæ (male) elongate, nearly as long as the body, black throughout; flagellar segments fusiform, about equally narrowed at both ends, each segment with a group of long erect setæ on the enlarged portion, these setæ about equal in length to the segments. Head gray.

Mesonotum dark brownish gray; pseudosutural foveæ black; scutellum and mediotergite concealed by mounting medium. Pleura brownish gray. Halteres with stem obscure yellow, the knob dark brown. Legs with the coxæ dark; trochanters obscure yellow; femora chiefly dark brown, the bases of fore and middle pairs restrictedly brightened; posterior femora yellow with the distal third or less darkened; tibiæ yellowish brown to brown; the tips darker; tarsi dark brown to black. Wings (Plate 1, fig. 22) with a weak dusky tinge; veins pale brown; macrotrichia a trifle darker. Venation: R_{2+3} longer than R_{4+5}, R_2 lying distad of level of r-m; petiole of cell M_3 about three times m-cu; vein 2d A relatively short, ending before m-cu.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 3, fig. 36) with the dorsal lobe, *db*, of basistyle elongate, relatively stout, the apex narrowed and glabrous;

ventral lobe shorter, with long, coarse, erect to retrorse setæ; a slender, fingerlike lobule on dorsomesal end, this provided at apex with a group of long setæ, not distributed along face as in *kempi*. Outer dististyle, *od*, sinuous to the acute apex, the surface microscopically roughened; inner dististyle, *id*, nearly as long, near base with a few coarse setæ, thence narrowed to an acute spinous point. Ædeagus, *a*, with lateral wings or flanges.

Habitat.—China (Kwangtung).

Holotype, male, Tsin-leong-san, altitude 2,750 feet, June 6, 1936 (*Gressitt*).

The nearest ally is *Molophilus kempi* Alexander (eastern Himalayas) which differs especially in the larger size, different coloration of the body and legs, and in the details of structure of the male hypopygium. There are several species of the *assamensis* subgroup in the Philippines and northern India, but none had hitherto been discovered in China or Japan.

STYRINGOMYIA SPATHULATA sp. nov. Plate 1, fig. 23; Plate 3, figs. 37 to 39.

Belongs to the *armata* group; male hypopygium with the median tergal lobe elongate, weakly spatulate, narrowest at near midlength; ninth sternite relatively narrow at apex, the two major setæ placed one on either side of midline; spines of basistyle terete or only weakly flattened, one arising from a conspicuous basal tubercle; dististyle with a long blackened spine at base of inner arm.

Male.—Length, about 7 millimeters; wing, 4.8 to 5.

Female.—Length, about 6 millimeters; wing, 4.

Rostrum brownish black; palpi dark brown, the terminal segment a little paler at outer end; flagellum chiefly pale. Head pale testaceous brown, the bristles of anterior vertex flattened and proclinate.

Mesonotum chiefly testaceous-brown, vaguely patterned with darker, including a central spot and narrow lateral borders on the pronotum. Dorsal pleura darkened, the ventral portion yellow. Halteres dusky. Legs with the femoral and tibial dark rings relatively vague and diffuse, slightly interrupted on lower surface. Wings (Plate 1, fig. 23) narrow, subhyaline, sparsely patterned with brown, including restricted seams on anterior cord, m-cu, outer end of cell 1st M_2, and distal end of vein 2d A; veins brown, darker in the clouded areas, the more basal and the costal veins paler. Costal fringe long and con-

spicuous. Venation: Anterior branch of Rs suberect; 2d M_2 short-petiolate; vein 2d A curved rather gently into wing margin.

Abdominal tergites yellowish brown, the extreme lateral and caudal margins of the individual segments a trifle darker; sternites slightly more testaceous. Male hypopygium with the median lobe of tergite (Plate 3, fig. 37, 9*t*) elongate, weakly spatulate, being narrowed at near midlength, the surface with abundant erect setulæ. Ninth sternite (Plate 3, fig. 37, 9*s*) with the apex relatively narrow, obtuse, the major setæ of moderate length, placed one on either side of the midline, the distance between their punctures about one-fourth the length of the seta itself. Basistyle (Plate 3, fig. 38, *b*) with two modified setæ, one subsessile, the other arising from a slender tubercle that is more than one-half the length of the seta itself, the latter strongly curved; setæ terete, not strongly flattened as in *armata*. Dististyle (Plate 3, fig. 39, *d*) with the outer arm bearing two very unequal setæ, the longest nearly one-half the length of the arm; along face of arm with a scattered series of about twelve small erect setæ; at base of arm a trifle group of about twenty-five black peglike spines; middle arm of style as figured; inner arm with its outer lobe high, the beak portion terminating in a compact group of about ten black spines; base of arm bearing a curved blackened spine.

Habitat.—Central Java.

Holotype, male, Nglirip, Djati forests, altitude 300 feet, January, 1936 (*Walsh*). Allotopotype, female, pinned with type. Paratopotypes, 3 males and females, with types.

The nearest allies of the present fly are *Styringomyia acuta* Edwards (Borneo) and *S. armata* Edwards (Sumatra, Borneo, Philippines), which have the bisetose basistyle of the group but differ in several details of the male hypopygium. The present fly is closest to *armata*, differing especially in the shape and structure of the modified setæ of the basistyle and the structure of the dististyle, especially the long curved spine at base of the inner arm. I have identified as *armata* specimens from Mindanao, and these differ from the present fly, not merely in the structures described, but also in the number and arrangement of the peglike blackened spines on the outer and middle arms of the dististyle. All three species are rather closely allied among themselves, but all seem to represent valid species rather than races.

STYRINGOMYIA PENDULA sp. nov. Plate 1, fig. 24; Plate 3, figs. 40, 41.

General coloration yellow, variegated with darker; head grayish white above, the posterior genæ infuscated; mesonotum variegated grayish white and brownish black; brown rings on femora and tibiæ broad and clear cut; wings whitish subhyaline, with dark seams on anterior cord, m-cu and outer end of cell 1st M_2; a conspicuous brown seam on basal half of vein Cu; anterior branch of Rs oblique, originating opposite r-m; male hypopygium with a single modified seta on basistyle; dististyle with its inner arm produced into a slender pendulous process that terminates in a long acute spine, along the margin with about six black points.

Male.—Length, about 7.5 to 7.8 millimeters; wing, 4.8 to 5.

Female.—Length, about 6 to 7 millimeters; wing, 4.2 to 4.3.

Rostrum and palpi brownish black. Antennæ with scape blackened beneath, yellow above; pedicel brownish black; flagellum chiefly pale, the more basal segments obscure yellow. Head grayish white above, the postgenæ infuscated; setæ of head stout but not flattened, chiefly proclinate.

Mesonotum variegated with grayish white and brownish black, forming a complex pattern on præscutum; central portion of scutellum almost white; setæ of thorax strong but simple. Pleura darkened dorsally, abruptly yellow on ventral portions. Halteres dusky. Legs with the usual yellow and dark-brown pattern, the brown rings complete and conspicuous. Wings (Plate 1, fig. 24) narrow, whitish subhyaline, sparsely patterned with brown, as follows: Anterior cord; m-cu and outer end of cell 1st M_2; a conspicuous seam on vein Cu, involving basal half of first section; distal third of vein 2d A darkened. Costal fringe long and conspicuous, erect. Venation: Anterior branch of Rs moderately oblique, originating opposite r-m; cell 2d M_2 very short-petiolate to broadly sessile; vein 2d A bent into margin at a moderate curve.

Abdominal tergites obscure yellow, with a vague darker median stripe; sternites light yellow, the lateral margins narrowly darkened; hypopygium yellow. Male hypopygium with the tergite (Plate 3, fig. 40, 9*t*) relatively narrow and pointed at apex; ninth sternite with apex glabrous, truncated, with the major setæ relatively short, about equal in length to the distance between them; on margin, on either side of the midline, with a microscopic spinous point. Basistyle (Plate 3, fig. 41, *b*) with a single modified bristle. Dististyle (Plate 3, fig. 41, *d*) as shown, the outer arm, *od*, dusky, with two unequal setæ at

and near tip; middle arm, *md*, with very numerous and complex groups of black spines; inner arm, *id*, produced into an acute sclerotized beak and bearing a long sinuous process that terminates in a slender point, the margin bearing about six black points.

Habitat.—Central Java.

Holotype male, Nglirip, Djati forests, altitude 300 feet, January, 1936 (*Walsh*). Allotopotype, female, pinned with type. Paratopotypes, both sexes.

The nearest ally of the present fly appears to be *Styringomyia soembana* Edwards (Soemba Islands), which differs chiefly in the coloration of the head and thorax and in the details of structure of the male hypopygium. The distinctly darkened seam along vein Cu is found in certain African species, such as *S. lineaticeps* Edwards and *S. marshalli* Edwards, but is not found in the regional allies of the present insect.

STYRINGOMYIA SEPARATA Alexander.

Styringomyia separata ALEXANDER, Philip. Journ. Sci. 56 (1935) 368, 369.

Described from northern Formosa. Several specimens, Hong San, Kiangsi, altitude 2,750 to 3,500 feet, June 24 to 29, 1936 (*Gressitt*).

TOXORHINA (CERATOCHEILUS) TAIWANICOLA (Alexander).

Ceratocheilus taiwanicola ALEXANDER, Philip. Journ. Sci. 22 (1923) 475, 476.

The species is wide-spread in the mountains of Formosa and is herewith recorded from southeastern China.

FORMOSA, Keinensan, altitude 5,400 feet, August 14, 1933 (*Issiki*), Fudieda, altitude 4,700 feet, August 13, 1933 (*Issiki*). CHINA, Hong San, Kiangsi, altitude 2,750 feet, June 25, 1936 (*Gressitt*).

ERRATUM

Due to a regrettable oversight certain of the illustrations for Parts XXXI [Philip. Journ. Sci. 60 (1936) 323] and XXXII [Philip. Journ. Sci. 61 (1936) 113] of this series have been transposed. Plate 1 at the end of Part XXXI belongs to Part XXXII, and Plate 1 at the end of Part XXXII belongs to Part XXXI. The author has kindly corrected this error in all the reprints distributed by him.—EDITOR.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b* basistyle; *d*, dististyle; *db*, dorsal lobe of basistyle; *dd*, dorsal dististyle; *g*, gonapophysis; *id*, inner dististyle; *md*, middle dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

Plate 1

Fig. 1. *Ptychoptera bellula* sp. nov.; venation.
2. *Ptychoptera javensis* sp. nov.; venation.
3. *Dolichopeza* (*Sinoropeza*) *paucisetosa* sp. nov.; venation.
4. *Dolichopeza* (*Nesopeza*) *fabella* sp. nov.; venation.
5. *Limonia* (*Dicranomyia*) *pacifera* sp. nov.; venation.
6. *Limonia* (*Geranomyia*) *sparsiguttata* sp. nov.; venation.
7. *Limonia* (*Geranomyia*) *spectata* sp. nov.; venation.
8. *Limonia* (*Geranomyia*) *subradialis* sp. nov.; venation.
9. *Limonia* (*Geranomyia*) *gracilispinosa* sp. nov.; venation.
10. *Limonia* (*Geranomyia*) *contrita* sp. nov.; venation.
11. *Helius* (*Helius*) *hæmorrhoidalis* sp. nov.; venation.
12. *Helius* (*Helius*) *aciferus* sp. nov.; venation.
13. *Orimarga* (*Orimarga*) *exasperata* sp. nov.; venation.
14. *Pseudolimnophila projecta* sp. nov.; venation.
15. *Hexatoma* (*Eriocera*) *quadriatrata* sp. nov.; venation.
16. *Teucholabis* (*Teucholabis*) *kiangsiensis* sp. nov.; venation.
17. *Gonomyia* (*Lipophleps*) *inquisita* sp. nov.; venation.
18. *Gonomyia* (*Lipophleps*) *subanxia* sp. nov.; venation.
19. *Gonomyia* (*Lipophleps*) *atrox* sp. nov.; venation.
20. *Idiocera* (*Ptilostenodes*) *uniplagiata* sp. nov.; venation.
21. *Cryptolabis* (*Bæoura*) *angustilobata* sp. nov.; venation.
22. *Molophilus injustus* sp. nov.; venation.
23. *Styringomyia spathulata* sp. nov.; venation.
24. *Styringomyia pendula* sp. nov.; venation.

Plate 2

Fig. 25. *Limonia* (*Dicranomyia*) *pacifera* sp. nov.; male hypopygium.
26. *Limonia* (*Geranomyia*) *sparsiguttata* sp. nov.; male hypopygium.
27. *Limonia* (*Geranomyia*) *subradialis* sp. nov.; male hypopygium.
28. *Limonia* (*Geranomyia*) *gracilispinosa* sp. nov.; male hypopygium.
29. *Helius* (*Helius*) *hæmorrhoidalis* sp. nov.; male hypopygium.
30. *Helius* (*Helius*) *aciferus* sp. nov.; male hypopygium.
31. *Orimarga* (*Orimarga*) *exasperata* sp. nov.; male hypopygium.
32. *Gonomyia* (*Lipophleps*) *subanxia* sp. nov.; male hypopygium.

Plate 3

Fig. 33. *Gonomyia* (*Lipophleps*) *atrox* sp. nov.; male hypopygium.
34. *Idiocera* (*Ptilostenodes*) *uniplagiata* sp. nov.; male hypopygium.

FIG. 35. *Cryptolabis* (*Bæoura*) *angustilobata* sp. nov.; male hypopygium.
36. *Molophilus injustus* sp. nov.; male hypopygium.
37. *Styringomyia spathulata* sp. nov.; male hypopygium, tergite and sternite.
38. *Styringomyia spathulata* sp. nov.; male hypopygium, apex of basistyle.
39. *Styringomyia spathulata* sp. nov.; male hypopygium, styli.
40. *Styringomyia pendula* sp. nov.; male hypopygium, tergite and sternite.
41. *Styringomyia pendula* sp. nov.; male hypopygium, styli.

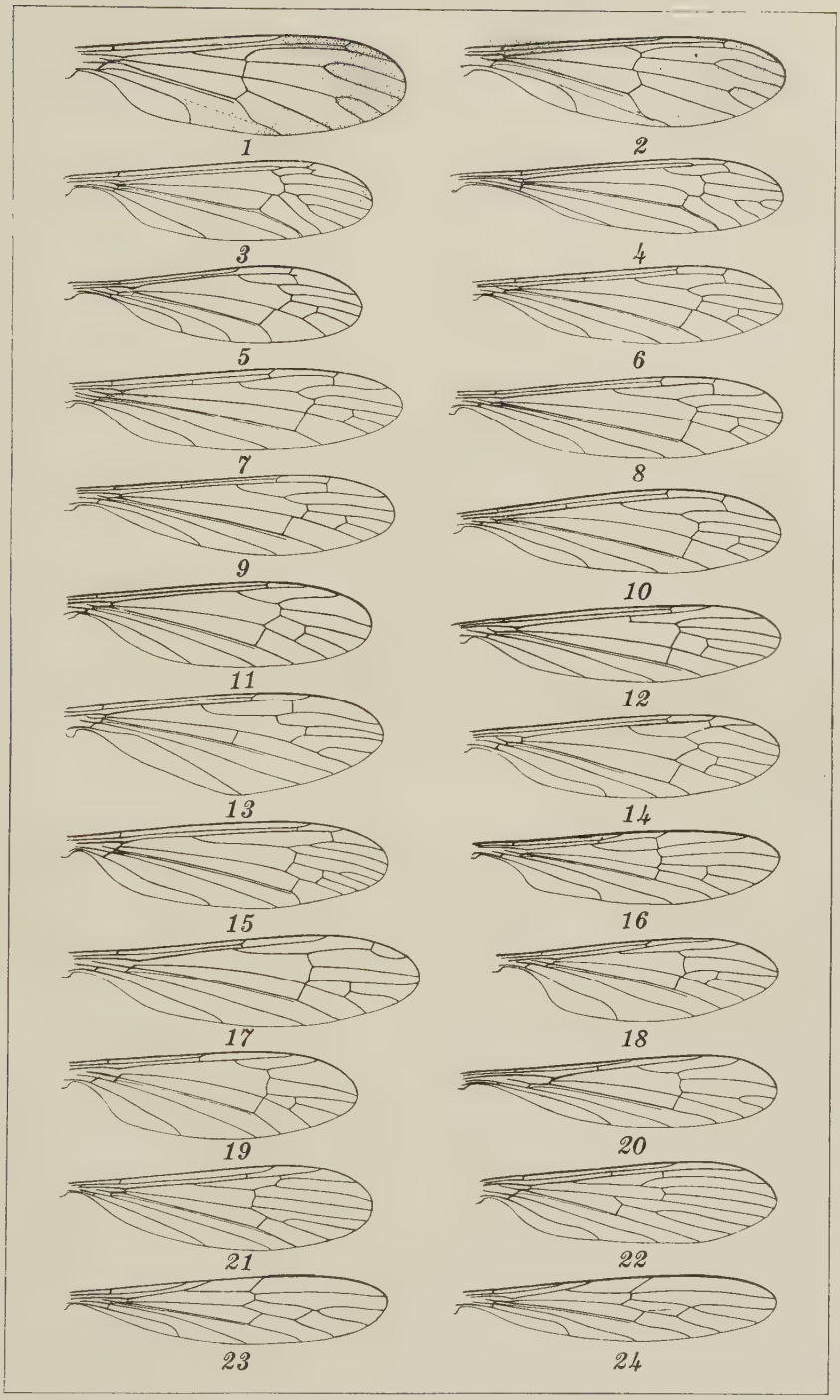


PLATE 1.

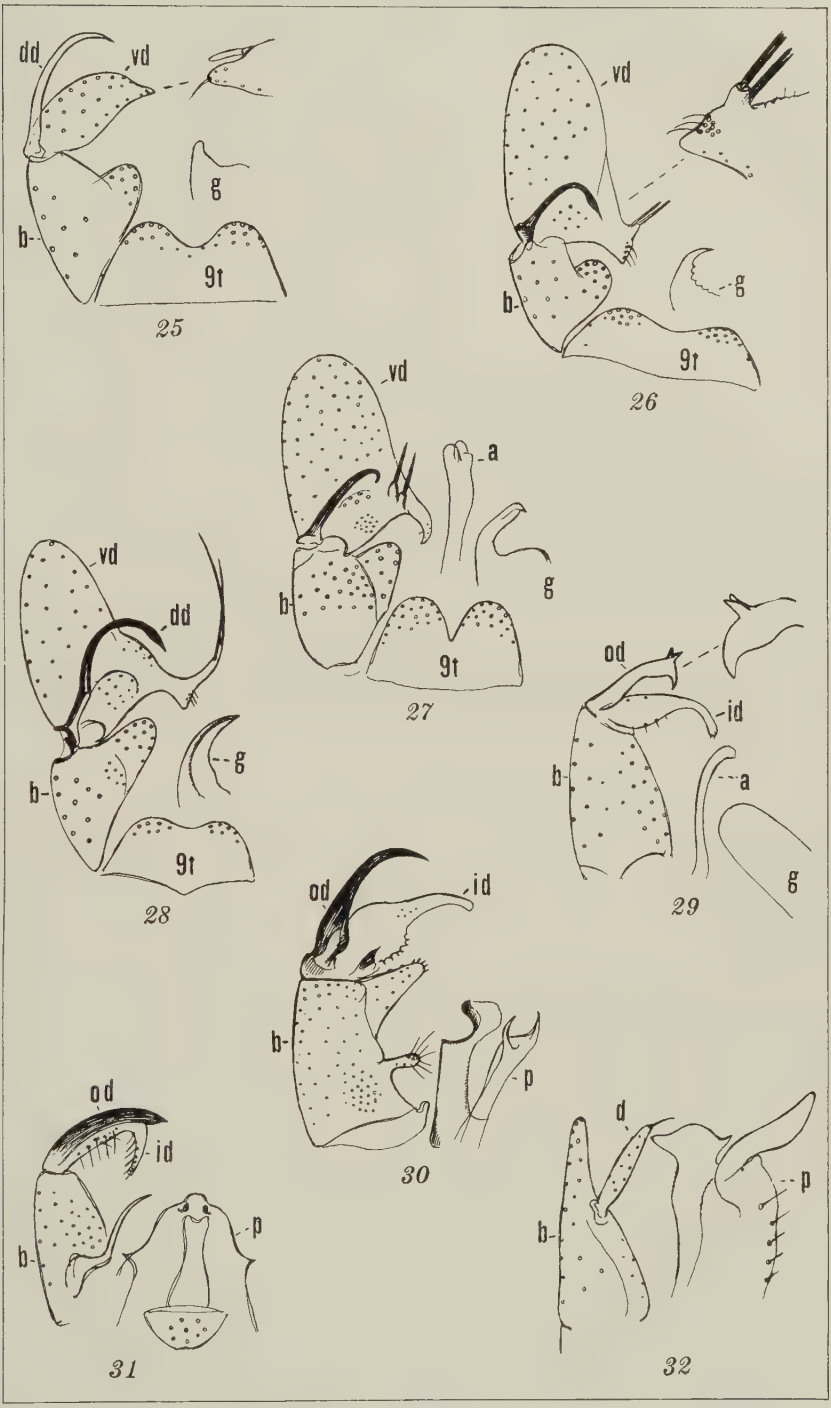

dd
vd
g
b
9t
25
vd
g
b
9t
26
vd
a
g
b
9t
27
vd
dd
g
b
9t
28
od
id
a
b
g
29
od
id
b
p
30
od
id
b
p
31
d
p
b
32

PLATE 2.

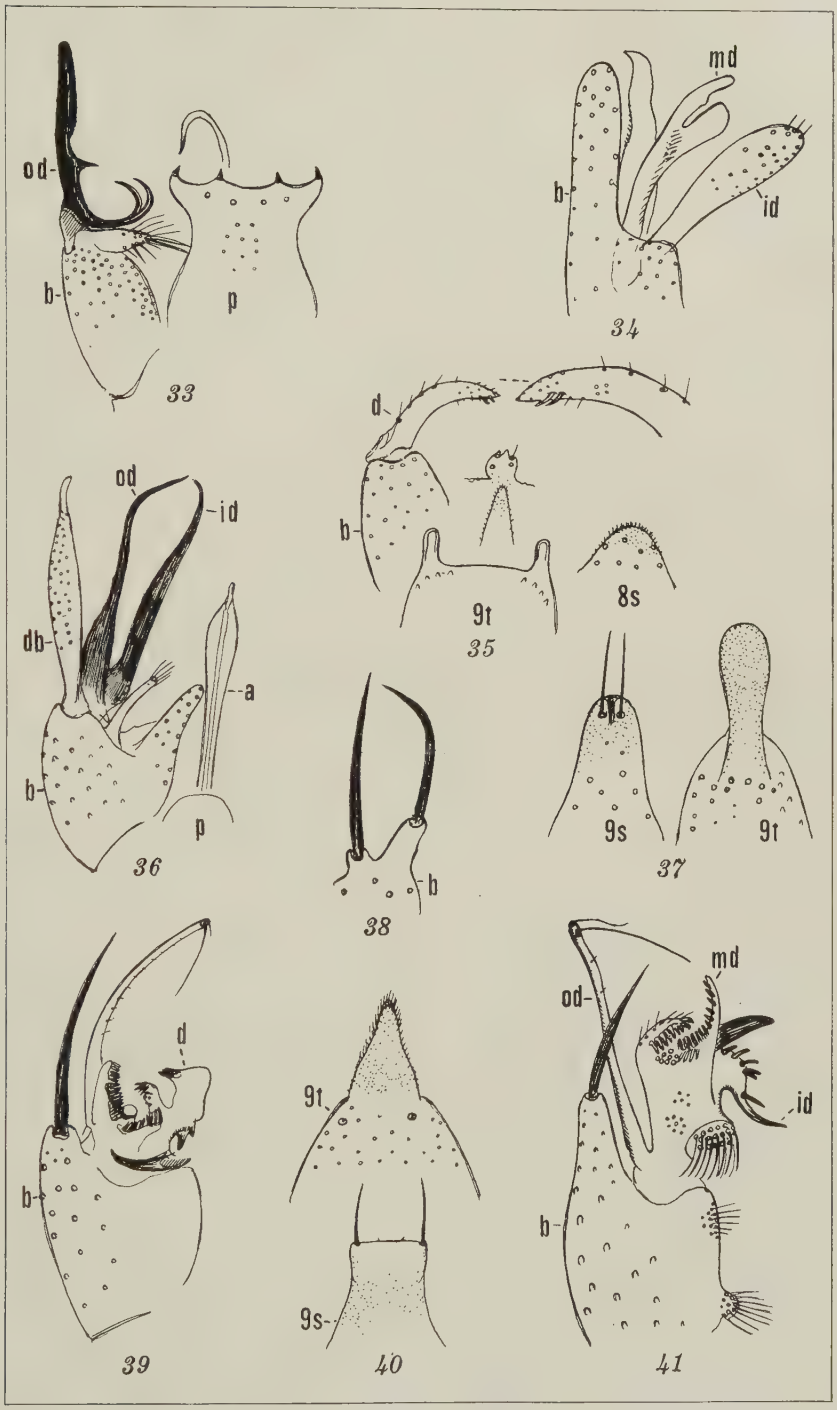

od
b
p
33
md
b
id
34
d
b
9t
8s
35
od
id
db
a
b
p
36
b
38
9s
9t
37
d
b
39
9t
9s
40
md
od
id
b
41

PLATE 3.

EFFECT OF DECORTICATION ON THE CONSTITUENTS OF PHILIPPINE GINGER

By Joaquin Marañon and Luz Ll. Cosme

Of the Bureau of Science, Manila

Ginger for export purposes may be either the dried undecorticated or the decorticated rhizome of the plant known botanically as *Zingiber officinale* Rosc. This plant is indigenous to the East Indies, but is now cultivated in many tropical countries.

In the work of Marañon and Caguicla [1] on Philippine ginger an attempt was made to ascertain whether this product could meet the requirements for ginger imported into the United States. A number of samples were analyzed, and it was found that many of them did not exactly conform to the United States standards. Some had less than the required amount of starch (42 per cent) while others contained more than the maximum quantity allowed for ash (7 per cent). Since the rhizomes analyzed were not peeled, we thought that decorticating them would alter their chemical composition sufficiently to meet the requirements of the United States standards. Accordingly a number of ginger samples, both decorticated and undecorticated, were analyzed. The results are recorded in this paper.

EXPERIMENTAL PROCEDURE

The ginger rhizomes used in this investigation were purchased in the Manila markets. They were first washed with water to free them from adhering particles of soil. The whole rhizome ("hand") was then split longitudinally into approximately equal halves. One half of the "hand" was peeled, or decorticated, by means of a scalpel, essentially according to the method described by Joachim.[2] The skin of the rhizome was merely scraped, and care was taken not to cut deeply and destroy the subepidermal cells, for these cells contain much of the oil that gives ginger its characteristic aroma.

The decorticated portions of the rhizomes were again washed and then dried in the sun. The other half of the "hand," which

[1] Philip. Journ. Sci. 58 (1935) 171.

[2] Trop. Agri. 83 No. 4 (1934) 214.

was not peeled, was also dried in the sun. After drying, the unpeeled and decorticated portions of each sample were ground and placed in glass stoppered bottles.

Twenty-two samples were analyzed in accordance with the directions given in the official methods for spices and other condiments.[3]

According to the United States Food and Drugs Act[4] dried ginger imported into the United States should conform to the requirements given in Table 1.

TABLE 1.—*Requirements for ginger imported into the United States.*

Constituent.	Per cent.
Starch	42 or more
Crude fiber	8 or less
Lime (CaO)	1 or less
Cold-water extract	12 or more
Total ash	7 or less
Ash insoluble in HCl	2 or less
Ash soluble in cold water	2 or more

The results of our analyses are given in Table 2. Comparing the data for both the decorticated and undecorticated rhizomes, we note that, by decortication, the chemical composition was, in general, changed in the following respects:

1. The amount of starch was increased very appreciably.
2. The crude fiber and the ash content were lowered considerably.
3. The ash soluble in water was reduced slightly.
4. Changes in the other constituents were not consistent.

Our experimental findings confirm our previous observations that, compared to foreign ginger, Philippine ginger is characteristically high in crude fiber, ash, and extractive matter (soluble in ether and alcohol) but rather low in starch content.

Decortication caused the composition of the ginger rhizome to approach more nearly the United States requirements. We found, however, that when the starch content was too low or the ash rather high, decortication did not produce sufficient change in these particular constituents to make the ginger conform to the United States standards.

[3] Methods of Analysis of the Association of Official Agricultural Chemists. 4th ed. (1935) 445.

[4] Dunn's Food and Drug Laws 1 (1927–1928) 132.

10883——4

TABLE 2.—*Analysis of undecorticated and decorticated ginger rhizomes.*[a]

Sample.	Condition of sample.	Moisture.	Cold-water extract.	Alcoholic extract.	Ether extract.	Crude fiber.	Starch.	Calcium oxide.	Ash.		
									Total.	Soluble in water.	Insoluble in HCl.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	Undecorticated	7.43	18.06	6.53	6.19	8.02	50.28	0.46	7.38	6.75	0.21
1A	Decorticated	8.18	14.85	4.56	5.67	5.11	54.80	0.25	6.65	6.26	0.31
2	Undecorticated	10.11	17.40	7.13	7.57	7.50	44.46	0.42	9.18	7.16	0.50
2A	Decorticated	9.23	16.70	6.02	7.49	5.73	47.18	0.35	8.18	6.93	0.54
4	Undecorticated	9.11	16.00	6.40	7.04	7.14	44.77	0.33	7.88	6.85	0.56
4A	Decorticated	6.52	15.10	5.29	6.26	5.26	51.61	0.20	6.92	5.86	0.59
5	Undecorticated	9.14	17.12	9.90	8.21	7.43	38.82	0.38	8.20	6.18	0.58
5A	Decorticated	9.27	16.71	9.42	7.91	5.00	46.37	0.21	7.00	5.83	0.65
6	Undecorticated	15.40	20.52	11.90	7.38	7.37	32.85	0.39	8.24	7.00	0.95
6A	Decorticated	13.06	24.45	12.27	7.68	5.39	36.27	0.46	8.17	6.99	0.86
7	Undecorticated	12.40	21.57	14.68	8.97	9.00	24.09	0.63	10.08	8.13	1.54
7A	Decorticated	16.13	20.92	16.50	6.85	7.84	29.99	0.64	8.87	7.45	1.20
8	Undecorticated	12.77	18.65	14.50	7.98	9.39	28.62	0.51	9.66	6.87	2.05
8A	Decorticated	15.03	18.20	15.30	8.81	7.30	31.70	0.66	8.46	6.47	1.42
9	Undecorticated	10.01	17.50	14.95	12.95	8.01	39.45	0.45	7.91	5.66	1.13
9A	Decorticated	14.39	17.33	15.45	10.15	6.85	48.37	0.46	6.95	5.19	0.85
10	Undecorticated	12.88	18.98	12.02	11.53	12.41	25.93	0.64	10.29	7.43	1.83
10A	Decorticated	12.68	19.35	13.67	13.72	8.94	31.70	0.62	9.25	6.93	1.91
11	Undecorticated	11.80	22.32	12.98	11.21	12.10	26.77	0.74	11.33	8.61	2.29
11A	Decorticated	12.36	23.35	17.01	13.58	10.29	28.91	0.95	9.41	7.53	1.73
12	Undecorticated	10.65	23.80	17.45	12.32	9.38	34.98	0.57	7.44	5.33	1.38
12A	Decorticated	10.24	24.72	18.17	11.48	7.71	42.18	0.61	6.15	5.13	0.89

[a] Percentages based on sun-dried samples. Each specimen of ginger was divided into two samples one of which was decorticated.

In order to produce Philippine ginger suitable for export it appears that the rootstock should be selected carefully for cultivation. Repeated cultivation and selection, as determined by analysis, should eventually produce a local ginger of satisfactory quality.

SUMMARY

By decortication the starch content of Philippine ginger was, in general, increased 14.9 per cent, while the ash was reduced 11.2 and the crude fiber 22.8 per cent.

Decortication also gave somewhat less water-soluble ash.

The effect of decortication on other constituents in the ginger rhizome did not give consistent results.

When the undecorticated ginger rhizome had an unusually low starch content or a rather high ash content, decortication did not produce sufficient change in these particular constituents to make the ginger conform to the United States standards.

PHYSIOLOGICAL ANATOMY OF THE LEAVES OF CUCURBITACEÆ

By H. L. CHAKRAVARTY

Of the Royal Botanic Garden, Sibpur, Bengal Province, India

ELEVEN PLATES

Although the anatomy of the stem and root of the Cucurbitaceæ has been sufficiently investigated, the physiological anatomy of their leaves has not yet been fully studied. Since the publication of Solereder's Handbook of the systematic anatomy of the dicotyledons, systematists have tried to utilize the facts of anatomy for purposes of classification. Investigation on the Cucurbitaceæ may be traced as far back as the middle of the eighteenth century, but much important research has been done on this group of plants during the latter part of the eighteenth and the early nineteenth centuries. Among early investigations may be mentioned the work of G. H. Kohl (1889) on the genera *Lagenaria* and *Momordica.* Martinet (1872), Vesque (1875), Eichler (1876), De Bary (1877), Weiss (1880), Arthur (1881), and other workers made valuable contributions, from both the morphological and the anatomical point of view. In 1881 Penzig first studied the cystoliths in the leaves of Cucurbitaceæ in *Momordica charantia* Linn. and *Momordica echinata* Spreng.[1] A. Fischer (1883), Uhlworm (1883), H. Molisch (1888), G. O. Müller (1889), Haberlandt (1889), Strasburger (1891), and Tognini (1894) have studied the family from different aspects.

In 1896 and subsequently A. Yasuda published a few original papers on some of the Japanese species of the Cucurbitaceæ, in which he attempted to classify this family on the basis of the arrangement of the vascular bundles on the midribs of the leaves. Zimmerman in his recent monograph made an elaborate study of the morphology, anatomy, and physiology of the African Cucurbitaceæ. Roland Holroyd in 1924 published a paper on the origin of the wood and bast vessels in the bundle in the Cucurbitaceæ. Holroyd states that, due to continued cambial activity, the mass of internal phloëm in the Cucurbitaceæ is

[1] Bot. Zentralblt. 8 (1881).

gradually enlarged to form the well-known bicollateral bundle. Grace Barkley in 1927 investigated the differentiation of vascular bundles in *Trichosanthes anguina* Linn., a species common in India.

Little work has been done, however, on the leaves of the Cucurbitaceæ; the few species that have been investigated are mostly confined to Europe, Africa, and Japan.

The presence of bicollateral bundles and other anomalous internal structures in this group, and its important economic and medicinal properties, have made it interesting for further investigation. In the present paper I have attempted to investigate the anatomical peculiarities of the leaves of cucurbitaceous species common in, and in the neighborhood of, Calcutta, India.

MATERIALS AND METHODS

The species studied, all of which are cultivated principally for their edible fruits, were the following:

Trichosanthes dioica Roxb.; Sans. *patola;* Hind. *parvar, pavul;* Beng. *patol.*

Trichosanthes anguina Linn.; Sans. *chichinda;* Hind. *chachanda;* Beng. *chichinga.*

Lagenaria vulgaris Seringe; Sans. *alabu, kututumby* (bitter variety) Hind. *kadu, lauki;* Beng. *lau.*

Luffa ægyptiaca Mill.; Sans. *ghia turai;* Hind. *purul;* Beng. *dhundul.*

Luffa acutangula Roxb.; Sans. *jhingaka;* Hind. *turai;* Beng. *jhinga.*

Benincasa cerifera Savi.; Hind. *gol kaddu, kudimah, kondha;* Beng. *kumra, chalkumra.*

Momordica cochinchinensis Spreng.; Sans. *karkataka;* Hind. *kakrol;* Beng. *kakrol.*

Momordica charantia Linn.; Hind. *sushavi, karela;* Beng. *karala, uchhya;* two seasonal varieties found in Bengal.

Cucumis melo Linn. var. *momordica;* Hind. *phut, phunt;* Beng. *phuti.*

Cucumis sativus Linn.; Hind. *khira;* Beng. *sasa.*

Cephalandra indica Naud.; Hind. *bimb;* Beng. *telakucha.*

Cucurbita pepo DC.; Beng. *kumra;* Hind. *safed kumra.*

Fresh material was used in most cases, in others, material preserved in 5 per cent formalin. Fine hand sections lightly stained in Delafield's hæmatoxylin and mounted in glycerine (from 10 per cent to 50 per cent) were found suitable for the examination of the cell contents. Sections stained properly in saffranin and hæmatoxylin for differentiation of tissue were used whenever required.

GENERAL ANATOMY OF THE LEAVES

Weiss determined that in the Cucurbitaceæ all bundles in the stem are leaf-trace bundles. In the petiole, at the points where

the veins branch off from the main bundles, the internal phloëm unites with the external, and hence the bundles in the leaf are longer bicollaterally.

The mesophyll tissue in the Cucurbitaceæ consists of both spongy and palisade parenchyma. The palisade tissue may consist of one or two layers, but the spongy tissue is generally three to seven cells thick.

TABLE 1.—*Number of layers of palisade and spongy cells, and average measurements in breadth of palisade and spongy tissues and lower and upper epidermis.*

Species.	Number of layers.		Average measurements.			
	Cells.		Tissue, in breadth.		Epidermis, in breadth.	
	Palisade.	Spongy.	Palisade.	Spongy.	Lower.	Upper.
			μ	μ	μ	μ
Trichosanthes anguina	1–2	2–5	63	30	25	35
Trichosanthes dioica	1–2	2–6	68	36	25	36
Luffa ægyptiaca	2	2	120	145	18	35
Lagenaria vulgaris	1	6	66	105	30	45
Luffa acutangula	2	2	160	155	21	42
Benincasa cerifera	1	3	85	96	77	52
Momordica cochinchinensis	2	2–6	36	35	23	42
Momordica charantia	2	2–4	26	25	13	22
Cucumis melo var. *momordica*	2	3–6	25	32	46	38
Cucumis sativus	2	2–7	24	48	36	52

SPECIAL STRUCTURES

(*a*) *Extrafloral nectaries.*—Extrafloral or extranuptial nectaries are common in most species of the Cucurbitaceæ. For the investigation of the general morphology and the physiological anatomy of the glands the following species were used: *Cephalandra indica* Naud., *Luffa acutangula* Roxb., *Luffa ægyptiaca* Mill., *Lagenaria vulgaris* Ser., *Cucurbita pepo* DC.

In *Cephalandra indica* there are a few dotlike glistening glands on the dorsal surface of the leaf, usually at the base on both sides of the midrib. A few more glands are scattered on the remaining parts of the lamina. They are never found on the leaf margin. They show no connection with the veins, as is the case with some other genera of the Cucurbitaceæ (Plate 1, fig. 3). In the early stages these glands consist of a few epidermal cells arranged in a circle below which there is ordinary mesophyll tissue. In a longitudinal section the gland is semicircular in appearance, its flat side being either continuous with the lower epidermis of the leaf or slightly depressed. It is surrounded by

a layer of semicircularly arranged suberized thick-walled cells, except on the epidermal side, the cells of which are rather thin-walled and nonlignified (Plate 3, fig. 11). The suberized tissue so arranged in a semicircle is termed superficial tissue. It is stained red by saffranin. Professor Zimmerman has observed a similar gland in *Fagraea fragans*. The superficial tissues have been regarded by some workers as having a certain resemblance to the endodermis. The cells within these superficial tissues are thin-walled, comparatively smaller, and devoid of chlorophyll. They essentially contain sugar in solution with water and other secretory substances. The superficial chain of cells in turn is surrounded by colorless patches of mesophyllous tissue with tracheidal ends. They may be termed supply patches, as they seem to supply the glands with secretory fluid. The liquid passes up to the tracheidal ends by transpiration and root pressure through cell to cell osmosis, but how this liquid passes from these patches to the glands proper through the mesophyllous cells is a question. The space between the tracheidal ends and the gland may be charged with high osmotic pressure, as sufficient amounts of osmotically active substance, that is, sugar in solution with water, has been found in these spaces. A membrane protects the outer flat end of the gland from the influence of the external environment. This membrane is permeable to the osmotic solution. The osmotic theory of the escape of fluid from these extranuptial nectaries is verified by the fact that the cells are charged with sufficient quantities of sugar solution. That other physico-chemical or biological phenomena do not take part in the escape of fluid cannot be confidently stated until this phenomenon has been subjected to further study.

Average length of glands, 560 μ; breadth, 122.

Thickness of the superficial cells forming the convex side, 22 μ.

In *Luffa acutangula* and *L. ægyptiaca* the morphological appearance of the leaf is closely allied, and the internal structure of the nectaries is more or less similar. In both the extranuptial nectaries are confined to either sides of the principal veins on the abaxial leaf surface. The nectaries are more crowded at the base of the lamina (Plate 1, fig. 1). A few glands are scattered on the remaining part of the lamina. In *L. ægyptiaca* the glands are less numerous and less distinct than in *L. acutangula*. The glands in these species agree with those of *Cephalandra indica*, except in the following respects: (*a*) they are smaller, (*b*) they protrude outward from the general level of the epidermal surface, (*c*) the superficial cells are more convex

but less suberized, (*d*) they are not surrounded by semicircular tracheidal patches.

A group of irregularly crowded mesophyllous cells of special form surround the gland and often have drops of sugar solution on them. A few tracheidal ends are scattered on the mesophyllous cells away from the superficial tissue.

Luffa acutangula, average length of gland, 528 μ; breadth, 80.

L. ægyptiaca, average length of gland, 320 μ; breadth, 112.

In *Lagenaria vulgaris* there are only two large lateral glands on the base of the leaf, at the junction of the blade and the petiole. The whole lamina is free from any other nectary except the vein ends of the leaf tooth, which are swollen and glandular in appearance. A few glands are also found on the margin of the leaf along with the tooth glands, and sometimes the tooth glands and marginal glands are jointed together (Plate 2, fig. 8). A longitudinal section of the gland shows the following internal structures: (*a*) A layer of thick-walled rectangular outer cells, (*b*) prominent suberized superficial cells, wavy to irregular in appearance, encircling a mass of reserve cells, (*c*) away from the superficial tissue, wavy or semiwavy parenchymatous tissue congregated together around the superficial layer of cells, covering a considerable area of the gland. These supply tissues often contain watery drops with abundant sugar in solution (Plate 3, fig. 10). The area further away from the supply tissue contains a number of tracheids (bundle ends). The tracheids no doubt are the channels through which secretory fluid escapes. While the glands are young they do not secrete nectar, but as they mature, the reserve cells disorganize and form a passage for the translocation of fluid outside the plant body (Plate 3, fig. 10).

On a sunny day fluid escapes profusely, and the secretion is often sucked by butterflies, moths, ants, and other insects.

The leaves of *Cucurbita pepo,* unlike those of other Cucurbitaceæ, have club-shaped glands covered with short hairs and attached with the veinlets on the lower surface (Plate 5, fig. 29). The extrafloral nectaries are peculiar in appearance. In a longitudinal section the glands, like those of other species, show a suberized superficial layer of cells at the end of the club-shaped gland, covering a small area. The tip of the gland is cup-shaped or semicircularly curved; its concave side lies toward, and the convex side away from, the gland; a few tracheidal strands run near about the superficial cells straight-away from the veins. The gland of this species is simpler in internal struc-

ture than in those mentioned above, as it merely contains a layer of curved superficial cells enclosing a few reserve cells. No specialized supply patches of mesophyllous tissue are present.

Different theories have been advanced regarding the function of these extrafloral or extranuptial nectaries. "According to Belt, Delphino and others these organs serve to attract protective ants" (Haberlandt). These nectaries occur on the leaves or on other vegetative organs, like bracts. Their position on the leaves and leaflike organs varies in different species. They are similar in structure to the floral nectaries, although they perform slightly different functions. They remain active for a longer period than floral nectaries. That the escape of watery liquid depends upon osmotic suction has been experimentally proved by Wilson (Haberlandt). Osmotic action is induced by the presence of sugar in the nectaries. The secretion of nectar probably contributes to the maintenance of the body temperature of the plant, and may also help in the exudation of waste products otherwise injurious to the plant body, and, last but not least, allures ants against injurious pests. There is a striking relationship in all the glands of the species examined. In every case there is a layer of superficial tissue of cells enclosing a mass of reserve cells, and a tracheidal arrangement in the form of patches or strands.

(*b*) *Cystoliths in the leaf of Momordica.*—The present investigation is based on the three species of *Momordica;* namely, *Momordica charantia* Linn., *Momordica cochinchinensis* Spreng., and *Momordica dioica* Roxb. The material was usually examined in a fresh condition, and mounted in 5 per cent glycerine whenever required.

In 1881 Penzig, studying the occurrence of cystoliths in the leaves of *Momordica charantia* and "*Momordica echinata* Wall.," [2] observed that the cystoliths are arranged in groups of two, three, or many. Penzig's observations on the occurrence of cystoliths only in the enlarged epidermal cells of the lower epidermis of the leaf have been confirmed by my own observations, but his results with regard to the occurrence in *M. charantia* of cystoliths mostly in groups of three to five do not coincide with my own findings. In the Indian species examined I have found about 60 per cent of the cystoliths arranged in groups of two; cystoliths in groups of three, four, and five to seven have

[2] According to Radlkofer, the latter plant is not *M. echinata* Wall.= *Echinocystis lobata* Torr. and Gray, but another species of *Momordica.*

also been met with in *Momordica charantia,* but groups from five to seven are rare and generally do not exceed 1 per cent. The cystoliths are uniformly distributed on the lower surface of the leaf. They do not occur in the petiole and they have no connection with veins or veinlets. The stalks of the cystolith are very short. The cystolith groups are all attached with the stalks and arise from a common center. The epidermal cells that encase the cystolith groups are much enlarged, being sometimes ten times as large as the ordinary epidermal cells. The calcium carbonate in the form of small globules strongly impregnates a cellulose skeleton. When the deposit of calcium carbonate (Ca CO_3) is dissolved by diluted hydrochloric acid (HCl diluted) the skeleton shows concentric stratification (Plate 5, fig. 27). That the skeleton is made up of cellulose is shown by the following chemical reactions: (*a*) It dissolves in cupra ammonia; (*b*) it swells and finally dissolves in concentrated sulphuric acid; (*c*) it stains blue with iodine and sulphuric acid.

Measured.	Length.	Breadth.	Point of contact.
	μ	μ	μ
Single group	25–32	25–32	12–14
Double group	55–75	32–44	20–24
Triple group	60–74	32–36	20–30

The cystoliths of the Indian *Momordica cochinchinensis* Spreng. do not seem to have been worked out by any previous worker. In this species they are arranged in groups of two to four, and, as in *Momordica charantia,* they are uniformly distributed on the lower surface of the leaf. No cystolith is found in this species arranged singly or in groups of more than four. The following percentage of distribution of the cystolith groups is approximately correct: Single, nil; double, 50 per cent; triple, 25 per cent; groups of four, 25 per cent.

The cystoliths are encased within enlarged epidermal cells of the lower surface of the leaf. There are as many of these enlarged epidermal cells as there are cystolith groups; that is, each epidermal cell encases a single cystolith group. Due to this abnormal growth of the epidermal cells the cystoliths are pushed to a considerable depth of the mesophyll, so that in a transverse section they often seem to arise from the mesophyllous tissue of the leaf.

Unlike the case in *Momordica charantia,* the cystoliths of *Momordica cochinchinensis* have no definite structure. They are irregularly branched and hence heteroplanous. Due to this irregular branching they show no definite shape (Plate 4, figs.

15 to 17). At the beginning of their formation they are more or less definitely oval, like those of *Momordica charantia,* but as they grow older they invariably branch off and develop into various fantastic structures. Calcium carbonate is strongly impregnated over a stratified branched cellulose skeleton. The cystoliths are either sessile or very shortly stalked. Their number in a square centimeter varies from 1,000 to 1,600, and in an entire leaf there may be as many as 100,000.

Length of cystoliths in groups of 2 to 4, 60 to 75 μ; breadth, 35 to 42; breadth of the point of contact, 12 to 14.

The cystoliths in the leaf of *Momordica dioica* are more or less similar to those in *Momordica charantia,* differing from the latter only in the slightly irregular shape of the cellulose skeleton impregnated with calcium carbonate.

The great number of cystoliths in a single leaf gives an idea of the enormous quantity of calcium carbonate in a single plant of *Momordica.* Calcium carbonate is an excretory product. During the process of metabolism a large quantity of lime otherwise useless to the plant body is deposited in the leaves. The plant on which cystoliths are found must therefore require a sufficient amount of lime for its life process. According to Haberlandt the deposit of calcium carbonate may be redissolved and utilized by the plant when it is in need of calcium food.

The rigidity of the definition of cystoliths, as having a stalk and a body of cellulose on which carbonate of lime is impregnated in the form of globules, and which have been compared by some authors with grape bunches or mulberry clusters, should not be maintained, as in *Momordica cochinchinensis* are found cystoliths having no stalk or a very small (invisible) one, and a body of most irregular structures. Zimmerman has examined a similar type of cystoliths in *Momordica rostrata* Zimmerman.

(*c*) *Cystolithlike structures or pseudocystoliths.*—Deposits of calcium carbonate forming definite cystolith structures are larger, but numerous other small deposits, or cells impregnated with them, have also been observed. In the basal cells of the hairs of *M. cochinchinensis* they are often met with. These groups of cystoliths are smaller than those appearing on the lamina, and have no definite stalk, nor are they encased within netlike cells; hence the term "pseudocystoliths" (Plate 4, fig. 18). In *Cephalandra indica* some of the upper epidermal cells are strongly impregnated with calcium carbonate. These deposits of calcium carbonate are arranged in separate groups which assume the dotted appearance on the adaxial surface

of the leaf. Held against light, they look like oil dots. Here the deposit is peculiarly on the upper surface of the leaf. The cells of the upper epidermis on which these deposits occur are somewhat enlarged, and the whole group of cells is sometimes completely impregnated with lime and shows free deposits of calcium carbonate (Plate 6, fig. 48).

(*d*) *Crystals in Momordica.*—Calcium oxalate crystals in the leaves of Cucurbitaceæ have not been sufficiently studied; in fact Professor Solereder remarks that he has never met with calcium oxalate crystals in the leaves of Cucurbitaceæ. Professor Zimmerman mentioned calcium oxalate in few species of *Momordica, Gerrardanthus, Luffa,* and *Physedra.*

The genus *Momordica* exhibits all over its body enormous deposits of calcium in the form of salts deposited in the plant body, as calcium carbonate in the form of cystoliths and as calcium oxalate in the form of crystals. Of these two different calcarious salts the former is largely confined to the leaves (lamina), and the latter is more or less confined to the stem and the petiole.

For the investigation of crystals only two species of *Momordica* have been examined, *M. charantia* and *M. cochinchinensis.* All specimens were collected from a locality near Calcutta, examined in a fresh condition, and mounted in 5 per cent glycerine.

Abundant crystals of calcium oxalate have been found in the petiole of both species. Most of the crystals are solitary. They are of rhombohydral types, belonging to the monoclinic system. Numerous other derivations of the monoclinic system in the form of twin or clustered crystals have also been found in abundance. Twin crystals (star-shaped) and combinations of the monoclinic and tetragonal systems with crystals of other different structures making complex or composite forms have been observed in the petiole of *Momordica charantia.* The twin crystals are mostly in the petiole, though a few may be found in the stem. The star crystals of *Momordica charantia* differ from those of *Momordica cochinchinensis* in having more projected and prominent star ends. The crystals in *Momordica cochinchinensis* are less numerous and smaller than in *M. charantia.* They are completely absent in the roots. In the stem the monoclinic crystals are most perfect and distinct, and larger. They are scattered throughout the ground tissue, though mostly confined to the cortical parenchymatous cells. They are absent in the epidermal cells and scarcely found in the vascular bundles.

If we trace the crystals from the petiole through the midrib to the leaf blade we find that their size gradually diminishes and the shapes loose their prominence, so much so that they are not distinguishable even under the high-powered lens of the microscope; hence the term "dust crystals" has been applied to them. These crystals are traceable up to half of the midrib but not beyond.

Momordica charantia, star-shaped crystals, 18 to 24 μ; tetragonal, 9 to 18.

Momordica cochinchinensis, star-shaped crystals, 9 to 12 μ; tetragonal, 7 to 10.

Crystals in the form of raphides and sphæraphides are not found in these species.

It is to be remembered that large amounts of calcium oxalate are manufactured in these plants as products of metabolism. Professor Haberlandt remarks that oxalic acid is formed in the plant body as a result of a variety of metabolic processes, particularly in connection with protein synthesis; but this substance is poisonous to the protoplasm and is accordingly rendered innocuous by combination with calcium to form the very insoluble oxalate of the metal. Calcium must therefore be present in the plant itself in large quantities. According to some workers this oxalate of lime, which is an excretory product, is redissolved by the plant once again when it is in need of calcium.

STOMATA AND HYDATHODES

Epidermal cells.—In general the epidermal cells are very wavy, but the cells on the adaxial surface of the leaf are less wavy than at the abaxial. Due to unequal thickening of the cell walls of the epidermal cells in *Lagenaria vulgaris* they have a dotted appearance, which is particularly marked when the leaf is in a fresh condition. Epidermal cells around the base of the hairs on *Cucurbita pepo,* and *Cucumis sativus* are very crowded.

The stomata in the Cucurbitaceæ show no peculiarity in structure. They are of very regular form, consisting of two identical guard cells of ordinary type. The epidermal cell all around the stoma show no peculiarity or congregation. The guard cells of the stomata contain 8 to 15 chloroplasts.

The average length of the stomata thus varies from 22 to 27 μ, the breadth from 12 to 18, and the pore length from 12 to 16.

TABLE 2.—*Average measurements of the stomata of Cucurbitaceæ based on five readings.*

Species.	Length.	Breadth.	Length of pore.
	μ	μ	μ
Luffa ægyptiaca	22	17	12
Trichosanthes dioica	26	18	15
Cephalandra indica	24	18	11.5
Lagenaria vulgaris	27	18	16
Cucurbita pepo	16	12	15
Luffa acutangula	22	15	12
Momordica charantia	22	15	13
Momordica cochinchinensis	25	18	15
Trichosanthes anguina	24	15	14

Hydathodes.—Hydathodes of different structures are present on the leaves of Cucurbitaceæ; there are in fact abundant devices for exudation on these leaves; namely, (*a*) epithem type of hydathodes, (*b*) ordinary stomata which have ceased to perform their normal function and are transformed for water exudation, and (*c*) the trichomatous hydathodes.

Leaf apices or leaf teeth in many cases show hydathodal structures. The epithem type of hydathode has been observed in *Cephalandra indica.* Here the prominent leaf teeth are formed of special brown cells (Plate 1, fig. 3). On a longitudinal section they show a mass of epithem tissue in the intercellular space which the tracheids (bundle ends) penetrate, but no definite hydathode is seen at the extreme end, as found by Professor Haberlandt in *Primula chinensis.* Instead of a single hydathode at the extreme end there are a number of loose cells at the end with intercellular spaces through which water possibly escapes. The brown leaf apex in *Cephalandra* does not grow much with the growth of the leaf, so that the brown tooth ends in their early stages do not differ much in size from those in old leaves. With the growth of the leaf blade two side lobes with brown teeth are traced. Only the main teeth are specialized, the rest merely showing thickened tips.

Glandular hydathodes in the form of trichomes consisting of four cells which afterwards divide into many cells are also met with on the leaf. At first (in *Cephalandra indica*) a cell destined to become a gland divides by a transverse wall into a stalk cell and a gland cell of nearly the same size. The stalk cell in contact with the epidermis does not grow much, but the body cell which performs the function of secretion divides by a transverse wall into two and then by a vertical wall into four cells; at the

four-cell stage it may divide again as in *Cephalandra indica*, where it is many-celled. The cells forming the body round off into a club-shaped structure, while the stalk is somewhat narrowed down (Plate 7, fig. 55). The cells of the glandular hair contain abundant protoplasmic substance.

The glandular hair in *Trichosanthes anguina* is peculiar. The stalk consists of a single cell and the body when mature consists of four cells forming the head. Each head cell contains a distinct nucleus around which cytoplasm is deposited, while the other portion of the cell may remain vacuolated.

In *Cucurbita pepo* there are 4 to 5 head cells (Plate 7, fig. 50). The formation of the gland is more or less like that of the above species. The hydathodes and water stomata perform the function of water exudation from the plant body. The leaf teeth of *Cucurbita pepo, Cucumis sativus, Cucumis melo,* and *Cucumis melo* var. *momordica* exhibit peculiar hydathodes at the tooth apices of the leaves. The leaf tooth is here much thickened and rounded. A fine transverse section through the tooth shows patches of thick rod-shaped epidermal cells separated from one another by a stoma (Plate 8, fig. 67). The cells of each rod at the extremity, that is, in contact with the hydathode, are the smallest. Each rod generally consists of 5 to 8 cells, and in a single tooth as many as sixteen hydathodes have been observed. That these hydathodes (aquatic stomata) are really the modified ordinary stomata is corroborated by the fact that similar respiratory cavities are found in these cases and that they are of nearly the same dimensions as the ordinary stomata.

Length of hydathodes, 21 μ; breadth, 10.5.

In a transverse section of a tooth of the species mentioned above only the side epidermal cells show hydathodes, the tip of the tooth being formed of a few loose cells.

The hydathodes here perform the function of a sieve, as water exudes out through all the aquatic stomata simultaneously. A large number of tracheids are present on the midregion of the tooth cell through which water is carried up. A layer of chlorophyll-containing cells surrounds the epidermis (Plate 8, fig. 67).

The Cucurbitaceæ are a family of the rainy season; the soil at that time contains much water and the atmosphere is almost saturated with water vapour, so the plant is likely to absorb much more water than it ordinarily requires. This circumstance explains the well-engineered hydathodal systems adopted by this family for rapid and easy discharge of water.

NONGLANDULAR HAIRS

The glandular hairs have already been described. Short or long multicellular hairs cover the adaxial and abaxial surfaces of the leaves of most Cucurbitaceæ.

On both surfaces of the leaf of *Lagenaria vulgaris* there are innumerable soft woolly hairs. The hairs on the lower surface are larger and cover the entire surface. Each hair consists of 3 to 4 cells in which protoplasm is uniformly distributed (Plate 8, figs. 65 and 66).

Two kinds of hairs are noted in *Cucurbita pepo*. Those on the upper surface are stiff, silicified, short uni-, bi-, or sometimes tricellular (Plate 9, fig. 68). The basal cells of the hairs perform the mechanical functions of resisting excessive pressure. The hairs on the lower epidermis (Plate 8, fig. 64) are longer, the basal cells supporting the hair are very strong, thick-walled, and crowded. The cytoplasmic matter is aggregated in some parts of the cell, leaving the other portions free from content.

The hairs of *Trichosanthes dioica* are strongly built and contain silica. These silica-containing hairs impart roughness to the leaf (Plate 9, fig. 70). Hairs on the leaves of *Luffa acutangula* contain in their basal cells deposits of lime crystals (calcium oxalate), which impart rigidity to the hairs (Plate 9, fig. 69).

On the upper surface of the leaf of *Cucurbita pepo* wax deposits are often met with. Wax deposited on the epidermal cells often partially or fully covers the pore of the stomata and thus prevents excessive transpiration.

PETIOLES

Lagenaria vulgaris.—Bundles 10, hollow at the base and solid at the end, with a vascular strand running through the hollow of the petiole making an angle of 45° in the anticlockwise direction from the point of attachment of the petiole with the branch.

Cucurbita pepo.—Bundles 13, arranged in a ring, sometimes one or two smaller bundles outside the ring; hollow throughout.

Luffa acutangula.—Bundles 8, arranged in a semicircle; solid throughout. The smallest bundle lies at the top.

Luffa ægyptiaca.—Bundles 9, arranged in a horseshoe structure; solid throughout.

Trichosanthes anguina.—Bundles 10, arranged in a horseshoe structure; solid throughout.

Trichosanthes dioica.—Bundles 7, arranged in a ring; solid throughout.

Benincasa cerifera.—Bundles 11 to 12, arranged in a ring; hollow throughout.

Cephalandra indica.—Bundles 7 to 8 in a ring; solid throughout (mucilaginous).

Momordica charantia.—Bundles 5, arranged in a horseshoe structure; solid throughout.

Momordica cochinchinensis.—Bundles 7, arranged in a horseshoe structure; solid throughout.

Cucumis melo.—Bundles 7 to 8, arranged more or less in a horseshoe structure. Solid throughout. The number of bundles in the petiole is never constant, varying in different parts of the same petiole.

MIDRIBS

The studies of A. Yasuda on Japanese species threw light on the systematics of the Cucurbitaceæ by his anatomical investigation of the midrib from the proximal part of the leaves. He described the following 6 types of arrangement:

1. A single vascular bundle; in *Actinostema racemosum, Schizopepon bryoniæfolius.*
2. Two vascular bundles, a large one on the middle and a smaller strand on the top; in *Melothria japonica.*
3. One large bundle and two small lateral strands; in *Gymnostema cissoides.*
4. Three vascular bundles, one large, and two small situated vertically above it; in *Benincasa cerifera, Cucumis sativus,* and *Lagenaria vulgaris.*
5. Four bundles arranged to form an almost right-angled cross, the lowest bundle being the largest; in *M. charantia,* species of *Luffa,* and *Trichosanthes.*
6. Seven vascular bundles forming a ring, the largest bundle situated below, the remaining strands above successively smaller, arranged symmetrically; in *Citrullus vulgaris* and *Cucurbita pepo.*

I have examined the midribs of 12 Indian species belonging to 8 genera and have noted some inconsistencies with the observations of Yasuda.

A single vascular bundle is not found in any of the species examined, but in *Momordica charantia* it is present in the midrib a little away from the petiole (Plate 10, fig. 72).

In *Benincasa cerifera* (Plate 11, fig. 79) three bundles are no doubt present and arranged, as described by Yasuda, all in a straight line, the lowest of them being the largest; but a fourth strand is also observed at the top of the third bundle. Yasuda's observations of the identical arrangement of vascular bundles in *Lagenaria vulgaris* (Plate 11, fig. 78) and *Cucumis sativus,* and their arrangement in a straight line, is not correct. In both

Lagenaria vulgaris and *Cucumis sativus* (Plate 11, fig. 81) there are four perfect bundles instead of three. In *Lagenaria vulgaris* the four bundles are arranged as follows: The lowest bundle largest, ring-shaped; the next two smaller bundles above it occupying a lateral position; the topmost bundle, which is the smallest, occupying a position at the head of the big basal bundle equidistant from the lateral ones (Plate 11, fig. 78). The topmost bundle in *Lagenaria* sometimes shows a compound form; that is, it is a combination of two bundles. In *Cucumis sativus* the second bundle lies vertically just above the largest one on the base, and the next two upper smaller bundles lie at the top of the intermediate one equidistant from it. *Cucumis melo* var. *momordica* shows exactly the same arrangement as *Cucumis sativus,* but the bundles at the top are very minute and look like strands.

The fifth arrangement of Yasuda, namely, four bundles arranged at right angles, the topmost the largest, as in *Momordica charantia, Luffa ægyptiaca, Luffa acutangula,* and *Trichosanthes anguina,* is quite in harmony with my observations, but in *Trichosanthes dioica* the fourth bundle at the top is not on the proximal part of the midrib.

The sixth arrangement of Yasuda, namely, seven vascular bundles forming a ring as in *Cucurbita pepo,* is correct, though occasionally an eighth bundle at the top, or sometimes 9 bundles, are also found; but whatever the number they are always arranged in a ring.

Two vascular bundles, one above the other, the lowest being the largest as is observed by Yasuda in *Melothria japonica,* are also found in *Cephalandra indica* (Plate 10, fig. 71). The arrangement of vascular bundles in *Momordica cochinchinensis* does not coincide with that of *M. charantia.* In *M. cochinchinensis* there are five bundles instead of four. The arrangement is otherwise similar to that in *M. charantia,* except that each of the two smallest bundles at the top lies above each of the intermediate lateral bundles (Plate 10, figs. 72 and 73).

Though the observation made by Yasuda on the arrangement of vascular bundles in the leaves of Cucurbitaceæ is not correct in all respects, it offers valuable suggestions for further systematic study, not only on the mere arrangement of the vascular bundles but also on the structure of the lowest, that is, the biggest bundle, which in most respects is peculiar to each genus.

The fourth bundle in *Luffa ægyptiaca, L. acutangula,* and *Lagenaria vulgaris,* seems to be the point of origin of many bun-

dles, as the number of bundles at any portion away from the petiole is often greater.

SUGGESTED AFFINITIES

From the anatomical details of the vascular bundles of the midribs of Cucurbitaceæ it has been possible to determine phylogenetic relationships between the members of the family, if the reduction of the number of vascular bundles is considered a principal criterion from the evolutionary point of view. The genus *Trichosanthes* seems to have a striking relationship with the genus *Luffa*. Of the two species of *Trichosanthes* studied, *T. anguina* most closely resembles *Luffa*, which also has four vascular bundles that are arranged crosswise, the lowest being the largest and the topmost the smallest. From the standpoint of the reduction of vascular bundles *T. dioica* seems to be derived from *T. anguina*, the topmost bundle of the cross being absent in the former. Moreover, *T. anguina* can still be found growing wild in our locality, while *T. dioica* is never found in a wild state and has undergone wide cultivation. Of the two species of *Luffa*, *L. acutangula* seems to be the more primitive. Here the topmost bundle may be taken as a compound one, made up of two bundles. In *Luffa ægyptiaca* the topmost bundle is perfectly single and there seems to be a tendency of further reduction of the number of bundles, as the two bundles at the middle are found joined in the proximal part of the midrib, and may in the course of time be fused and reduced to a single bundle. *Momordica charantia* seems to be derived from *Momordica cochinchinensis*. The latter species contains five vascular bundles at the midribs, while in the former we find only four bundles at the base of the midrib. Four bundles are present only at the very beginning of the midrib, but all the three top bundles do not occur at other portions of the midrib, where only a single vascular bundle is to be seen.

Cucumis sativus seems to be more primitive than *Cucumis melo;* of the four vascular bundles of the latter species, three at the top are on the verge of extinction. *Benincasa cerifera* [3]

[3] Characters common in *Benincasa* and *Cucurbita* are: Large climbing herbs, soft hairy tendrils 2- to 4-fid in *Cucurbita* but 2-fid in *Benincasa*. Leaves cordate, 5-angular or lobed; petioles without glands. Flowers large, yellow monœcious, all solitary, without bracts. Male, calyx tube campanulate, lobes 5-linear or foliaceous; corolla campanulate, 5-lobed; stamens 3, inserted in the calyx tube. Female, calyx and corolla as in the male; ovary oblong; ovules many-horizontal; placentas 3. Fruits fleshy, large, indehiscent; seeds compressed.

Loureiro (1790), in his Flora Cochinchinensis, named it as *Cucurbita pepo* Lour. C. L. Blume (1826) in his "Bydragen tot de van Nederlandsch Indie" designated it as *Cucurbita ferinosa* Blume, and Wallich in his catalogue No. 6723 described it as *Cucurbita hispida* Wall., which from its external appearance seems to have much similarity to *Cucurbita pepo;* so much so that authors like Loureiro, Blume, and Wallich placed *Benincasa cerifera* as a species of *Cucurbita;* but the number of vascular bundles (seven) and their arrangement (in an ellipse) in *Cucurbita pepo* differ greatly from those of *Benincasa cerifera,* which has four vascular bundles lying in a straight line. This arrangement may be explained by the fact that each two side bundles at the top of *Cucurbita pepo,* except the basal one which is the largest, approach one another and finally fuse to a single bundle, and as a result there are three bundles in a straight line just above the basal bundle, the exact arrangement in *Benincasa cerifera. Benincasa* may therefore be regarded as an advanced form of *Cucurbita. Cephalandra indica,* which contains only two vascular bundles in the midrib, seems to have no relation to any of the above species. It may have branched off at a remote period from some unknown group of Cucurbitaceæ.

CONCLUSION

Most of the species of the Cucurbitaceæ examined are equipped with strikingly interesting adaptations for the discharge of superflous fluid from the plant body. The excretion of aquatic fluid seems to be very important in all these species. Hence, apart from the presence of innumerable hydathodal hairs in nearly all of them, which perform an important function for the drainage of water, various other structures in the form of glands and nectaries have developed. It is evident that cucurbitaceous plants, being mainly plants of the rainy season, absorb unusual quantities of water from the soil or from rain water, so that they require well-engineered structures for easy and rapid discharge of the excess intake of water. Therefore we find sieve and epithem types of hydathodes in addition to other devices.

Some genera of the Cucurbitaceæ, like *Momordica, Cephalandra,* and *Cucurbita,* seem to have a high calcium requirement, and for the utilization of lime food have reservoirs of calcium in the form of cystoliths and crystals, ready for immediate use. Anatomical arrangement of the midribs and petioles seems to

have much importance in the classification of the family into groups, from the evolutionary as well as from the taxonomic point of view.

SUMMARY

1. Extrafloral nectaries are present in the leaves of (*a*) *Cephalandra indica* on the leaf base of the blade, (*b*) in *Luffa acutangula* and *Luffa ægyptiaca* all over the lamina, (*c*) and in *Lagenaria vulgaris* as two lateral glands on the petiole and a few at the leaf tooth.

2. All glands show the presence of sugar and have special devices for the discharge of osmotically active fluid. The glands of the Cucurbitaceæ are characterized by a superficial layer of cells that covers a group of reserve cells.

3. The presence of heterophanous branched cystoliths enclosed within enlarged lower epidermal cells of the leaf in *Momordica cochinchinensis* invalidates the definition of cystoliths generally adopted in text books, and further casts light on the formation and deposit of lime in plant cells.

4. The genus *Momordica* alone shows the presence of solitary, clustered, or twin crystals and crystal dusts of various structures.

5. Arrangement, number, and nature of vascular bundles in the midribs and petioles of cucurbitaceous leaves maintain an individuality of character in a particular genus or even in a species, so much so that they facilitate the identification of the genus from knowledge of the anatomy of the midrib and the petiole.

6. Cucurbitaceæ are equipped with facilities for the rapid drainage of superfluous water. Water stomata and hydathodes of different structures (sieve and epithem types and glandular hairs) are abundantly present.

7. The hairy coverings on the leaves of *Cucurbita pepo, Luffa acutangula,* and *Momordica cochinchinensis* are peculiar. Calcium crystals, known as pseudocystoliths, are deposited in some of the hairs.

8. On the basis of the anatomical knowledge of the leaf in the Cucurbitaceæ the relationship of the genera may be traced from the evolutionary standpoint.

ACKNOWLEDGMENT

In conclusion I wish to express my indebtedness to Prof. Dr. S. P. Agharkar under whose direction this work has been completed.

BIBLIOGRAPHY

1. Alten, H. von. Kritische Bemerkungen und neue Ansichten über die Thyllen. Bot. Zeit. Abt. 1, Heft 1 67 (1909) 1.
2. Arthur, J. C. Trichomes of Echinocystis lobata. Bot. Gaz. 6 (1881) 180–3, pl. 1.
3. Baranetzky, J. Recherch. faisceaux bicollat. Ann. Sc. Nat. VIII 12 (1900) 276–278, 301–306.
4. Boodle, L. A., and F. E. Fritsch. Solereder's Systematic Anatomy of the Dicotyledons 1 (1908) 389–397; 2 (1908) 936–939.
5. Barkley, Grace. Differentiation of vascular bundles of Trichosanthes anguina. Bot. Gaz. 83 (1927) 173–84, pl. 13.
6. Chakravarty, H. L. Occurrence of lime in edible Momordica. Current Science 4 (1935) 239–240, 261–262.
7. Dana, E. S. A text book of Minerology (1905).
8. De Bary, A. Comparative Anatomy of the Dicotyledons and Ferns (1877).
9. Delphino, Friderigo. Org. Caratterist. di alc. Cucurbita, Mem. Accad. Sci. Bologna. V 9 (1901–1902) 383 et seq., pls. 1–3.
10. Dutailly, G. Écailles glandulif. Bull. Soc. Bot. Linn. de Paris 6 (1875).
11. Eichler, A. W. Zur Entwicklungsgeschichte der Blüte 8 (1861) 4, pl. 2.
12. Faber, F. C. Bicolla. Gefässbündel von Cucurbita pepo. Ber. deutsch. bot. Gesellsch. 22 (1904) 269–303, pls. 17, 18.
13. Faber, F. C. Zur Entwicklungschichte der bicollateralen Gefässbündel von Cucurbita pepo. Ber. deutsch. bot. Gesellsch. 22 (1903) 296–304.
14. Fischer, A. Siebröhrensyst. von Cucurbita. Ber. deutsch. bot. Gesellsch. (1883) 276–9.
15. Fischer, A. Untersuchungen über das Siebröhrensystem der Cucurbitaceen. Berlin (1884) 109, pl. 6.
16. Fries, Rob. E. Zwei südamerikan. Llianen. Botaniska shidier tilägn, Kjellman. Upsala (1906) 89.
17. Gilg, E. Cucurbitaceae Africanae II. Bot. Jahrb. 34 (1905) 343.
18. Haberlandt, G. Physiological Plant Anatomy (1924).
19. Holroyd, R. Morphology and Physiology of the axis in Cucurbitaceae. Bot. Gaz. 78 (1924) 1–44, pls. 1–3.
20. Kirtiker, K. R., and B. D. Basu. Indian Medicinal Plants, pt. 1 (1918) 578–609.
21. Kohl, F. G. Zur Kalkoxalat-Bildung in der Pflanze, vorläufige Mittheilung. Bot. Centralbl. 38 (1889) 471–475.
22. Kohl, F. G. Entgegnung auf Herrn Dr. Wehmer's Mittheilung zur Calciumoxalat-Frage. Bot. Centralbl. 38 (1889) 649–652.
23. Kohl, F. G. Wissenschaftliche Original-Mittheilungen über Wachstum und Eiweissgehalt vegetabilischer Zellhäute. Bot. Centralbl. 37 (1889) 1–6.
24. Kunth, J. I. Handbuch der Blütenbiologie. Leipzig (1898–1899).
25. Küster, E. Physiologische Pflanzenanatomie. Jena (1903).
26. Martinet, M. J. Organes de secretion des végétaux. Ann. Sc. Nat. V 14 (1872) 91–232, pl. 10, fig. 96.

27. MOLISCH, R. Zur Kenntnis der Thyllen, nebst Beobachtungen über Wundheilung in der Pflanze (Sitzgb. d. k. k. Akad. Wiss. Wien **97** Abt. 1 (1888) 264.
28. MÜLLER, G. O. Nat. Pflanzenfam. pt. 3 Abt. 5 (1889) 3–4.
29. PENZIG, OTTO. Zur Verbreit. der Cystolithen im Pflanzenreich. Bot. Centralbl. **8** (1881) 393–401, pls. 2–4.
30. PETTERSON, O. G. Engler über das Auftreten bicollateraler Gefäss-Bündel in verschiedenen Pflanzenfamilien. Bot. Jahrb. **3** (1882) 372–77.
31. STRASBURGER, E. Bau u. Verr. (1891) 283.
32. UHLWORM, OSCAR. Beiträge zur Entwicklungsgeschichte der Trichome. Bot. Zeit. **31** (1873) 773, pls. 9, 10.
33. WEISS, J. E. Anat. und Phys. fleischig verdickter Wurz. Flora **63** (1880) 109–11, pl. 4.
34. YASUDA, A. Cystoliths. Bot. Mag. Tokyo **10** (1896).
35. YASUDA, A. Comparative Anatomy of the Cucurbitaceae (in Japanese). Bot. Mag. Tokyo **15** (1901) 88–91.
36. YASUDA, A. Comparative Anatomy of the Cucurbitaceae. Journal of the College of Science, Imperial University, Tokyo **18** (1903) 56, pl. 5.
37. ZIMMERMANN, A. Die Cucurbitaceen. Jena. Verlag Gustav Fischer (1922).

ILLUSTRATIONS

Plate 1

Fig. 1. Leaf of *Luffa acutangula*, showing the general distribution of the extrafloral nectaries over the lamina, on either sides of the prominent veins. × 0.5.

2. A part of the lower surface of the leaf of *Cucurbita pepo*, showing club-shaped glands. × 0.5.

3. Leaf of *Cephalandra indica* showing the basal position of the glands and the specialized leaf tooth. × 0.5.

4. Leaf of *Momordica charantia* showing minute dots of cystoliths. × 0.5.

Plate 2

Fig. 5. Leaf of *Trichosanthes anguina*. × 0.5.

6. Leaf of *Trichosanthes dioica*. × 0.5.

7. Young leaf of *Momordica cochinchinensis* showing innumerable cystolith dots over the lamina. × 0.5.

8. Young leaf of *Lagenaria vulgaris* with two lateral glands. × 0.5.

9. A part of the lower surface of the leaf of *Cucurbita pepo* showing the shape of the gland. × 10.

Plate 3

Fig. 10. Longitudinal section of gland at right angle to the leaf lamina of *Lagenaria vulgaris*, showing superficial layer of cells, disorganized reserved cells, supply tissue with sugar drops, and tracheidal ends. × 50.

11. Longitudinal section of gland at right angle to the lamina of *Cephalandra indica* with tracheidal patches around it. × 75.

12. Longitudinal section of gland at right angle to the lamina of *Cucurbita pepo*. × 25.

13. Longitudinal section of gland at right angle to the lamina of *Luffa acutangula* with sugar drops on the supply tissue. × 75.

14. Same as above. × 175.

Plate 4

Figs. 15 to 17. Cystoliths from the leaf of *Momordica cochinchinensis;* heteroplanous, branched and with enlarged epidermal cells encasing the cystolith groups. × 175.

Fig. 18. An epidermal hair from the leaf of *Momordica cochinchinensis*, showing pseudocystoliths in the basal cells of the hair. × 175.

Figs. 19 to 22. Two, three, four, and seven groups of cystoliths respectively in *Momordica charantia*. × 225.

PLATE 5

FIGS. 23 and 24. Double groups of cystoliths in *M. cochinchinensis*. × 220.
25 and 26. The cellulose skeleton of cystoliths from *M. cochinchinensis*, showing concentric stratification when calcium carbonate is dissolved in diluted HCl. × 220.
FIG. 27. The cellulose skeleton of the cystoliths of *M. charantia* in groups of seven when calcium carbonate is dissolved in diluted HCl. × 275.
FIGS. 28 to 30. Position of cystoliths in the enlarged epidermal cells and their mode of attachment. × 220.

PLATE 6

FIGS. 31 to 43. Various structures of crystals found in *M. charantia*. × 1,250. Figs. 30, 32, and 43 show twin (star-shaped) crystals.
44 to 48. Various structures of crystals found in *M. cochinchinensis*. × 1,250. Fig. 48 shows twin star-shaped crystals.
FIG. 49. Transverse section of the leaf of *Cephalandra indica*, showing the deposit of calcium carbonate in the upper epidermal cells. × 290. Complex crystals are shown in figs. 42 and 44 to 46.

PLATE 7

FIG. 50. A glandular hair of *Cucurbita pepo*. × 305.
FIGS. 51, 55, 57, 58, and 60. Different stages of the glandular hairs of *Trichosanthes anguina* (Cytoplasm with distinct nucleus). × 305.
FIG. 52. Net work of veins in *Trichosanthes dioica*. × 110.
FIGS. 53, 54, 55, 59, and 61. Glandular hairs of *Cephalandra indica*. × 305.
FIG. 63. A stoma from the leaf of *Cephalandra indica*. × 624.

PLATE 8

FIG. 64. Nonglandular hair from the lower surface of the leaf of *Cucurbita pepo*. × 305.
FIGS. 65 and 66. Nonglandular hairs from the lower surface of the leaf of *Lagenaria vulgaris*. × 305.
FIG. 67. Longitudinal section of the leaf tooth at right angle to the lamina of *Cucurbita pepo*, with sieve type of hydathodes. × 330. Hydathodes are arranged between bands of thickened epidermal cells.

PLATE 9

FIG. 68. Hairs from the upper surface of the leaf of *Cucurbita pepo*, with strong deposit of silica. × 260.
69. Hair from the leaf of *Luffa acutangula*, with deposit of lime. × 260.
70. Hair from the leaf of *Trichosanthes dioica*, with deposit of silica. × 260. Transverse section of the midribs of the leaves of different species from the proximal part of the petioles. × 40.

PLATE 10

FIG. 71. *Cephalandra indica.*
72. *Momordica charantia.*
73. *Momordica cochinchinensis.*
74. *Luffa aegyptiaca.*
75. *Luffa acutangula.*
76. *Trichosanthes dioica.*

PLATE 11

FIG. 77. *Trichosanthes anguina.*
78. *Lagenaria vulgaris.*
79. *Benincasa cerifera.*
80. *Cucurbita pepo.*
81. *Cucumis sativus.*
82. *Cucumis melo* var. *momordica.*

PLATE 1.

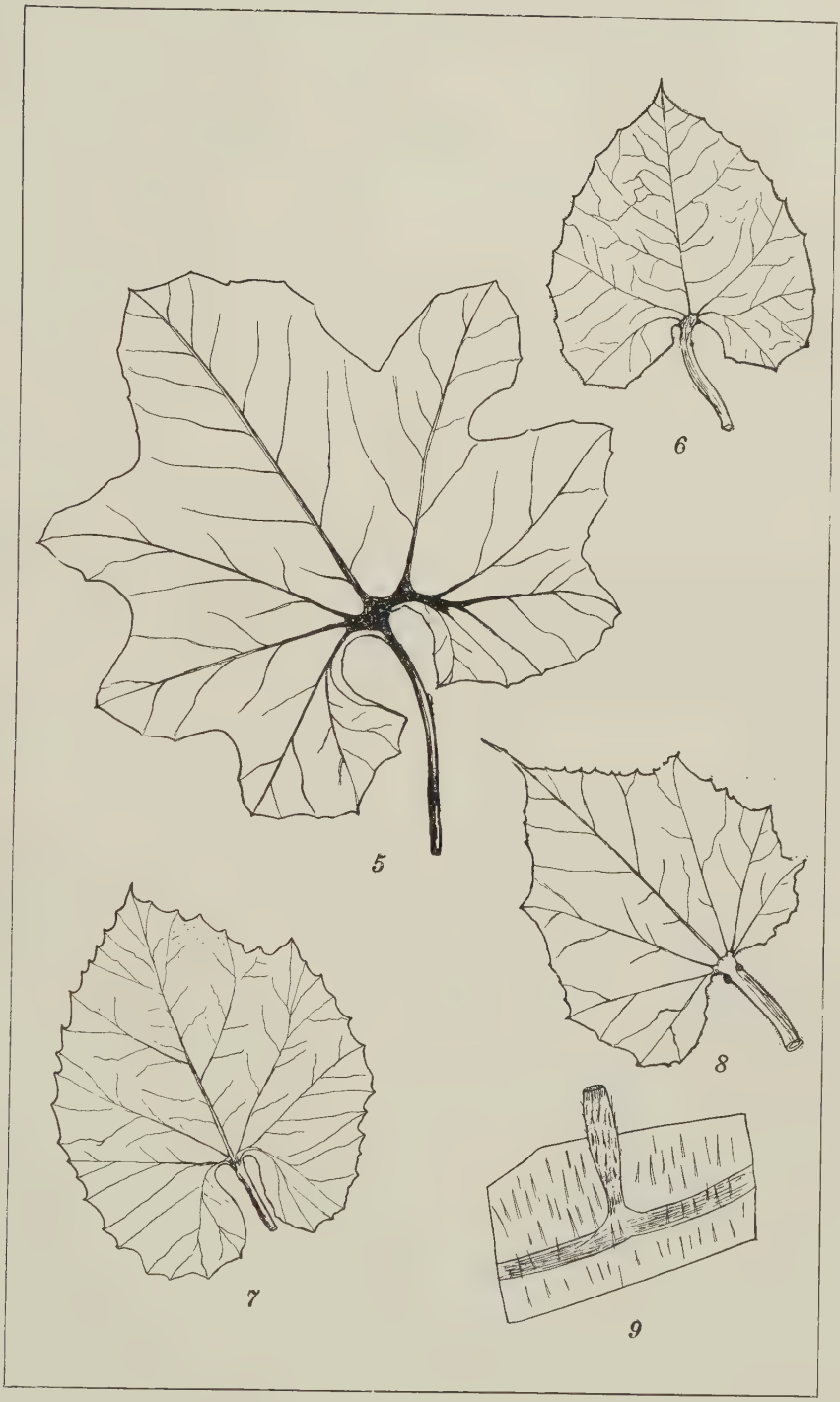


PLATE 2.

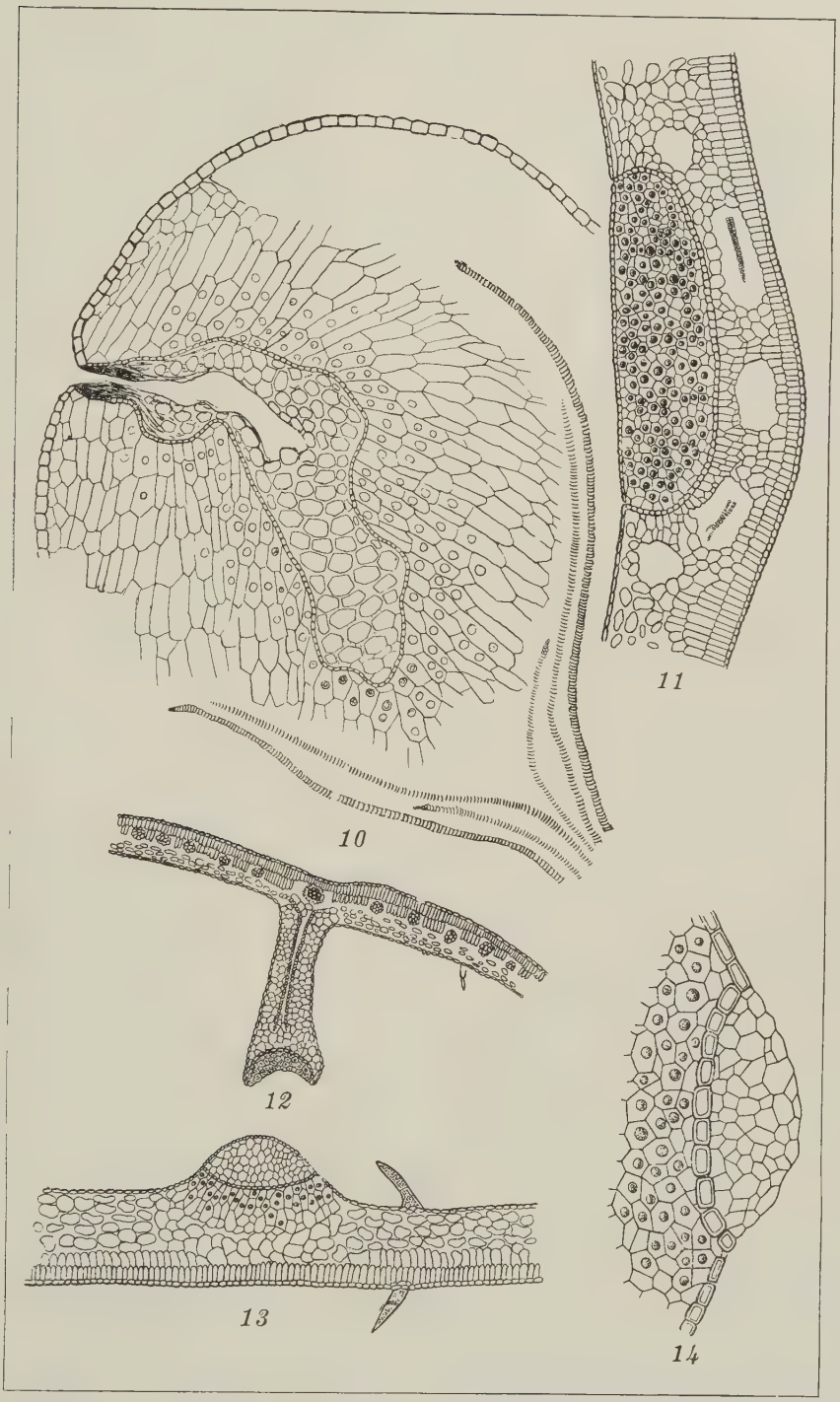


PLATE 3.

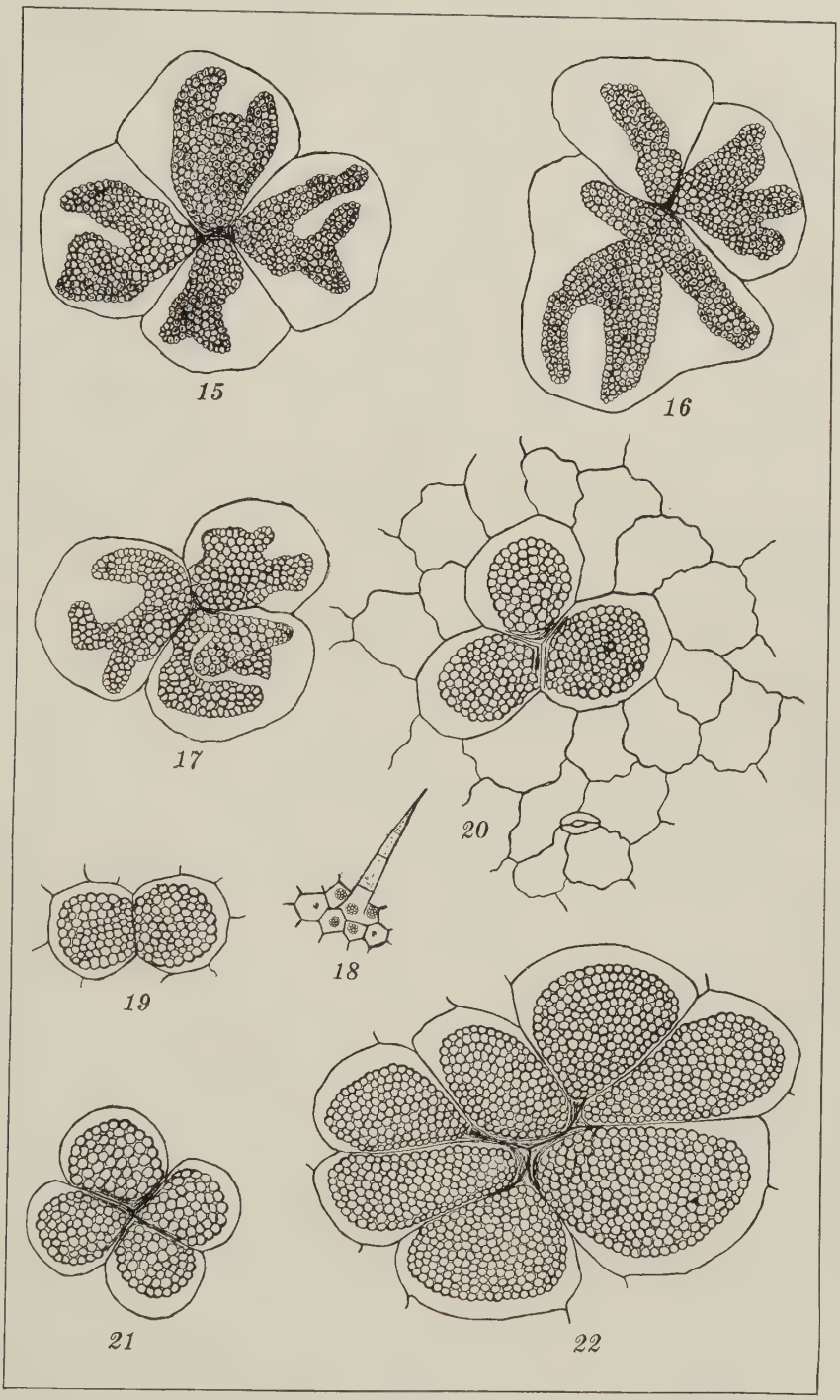


PLATE 4.

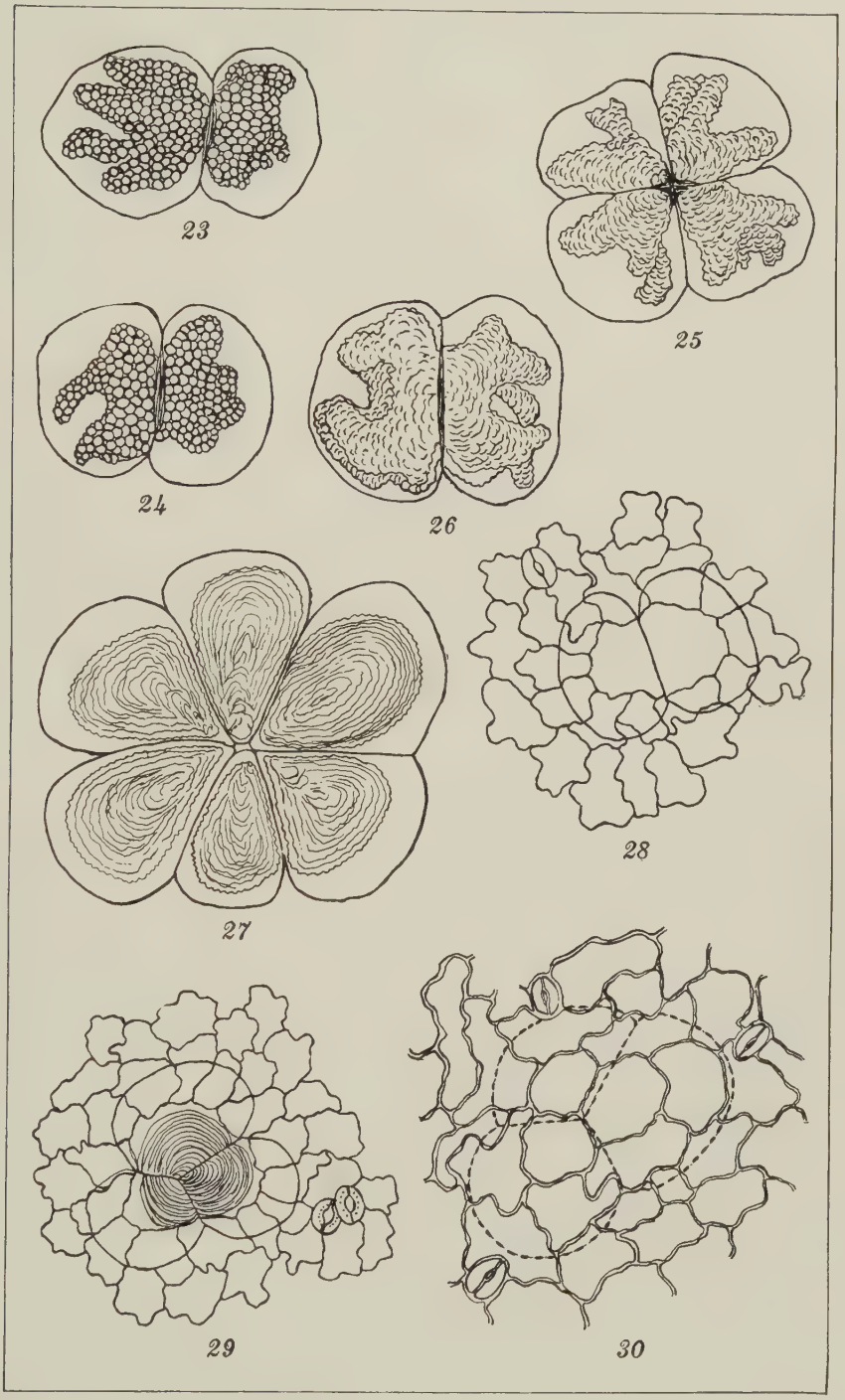


PLATE 5.

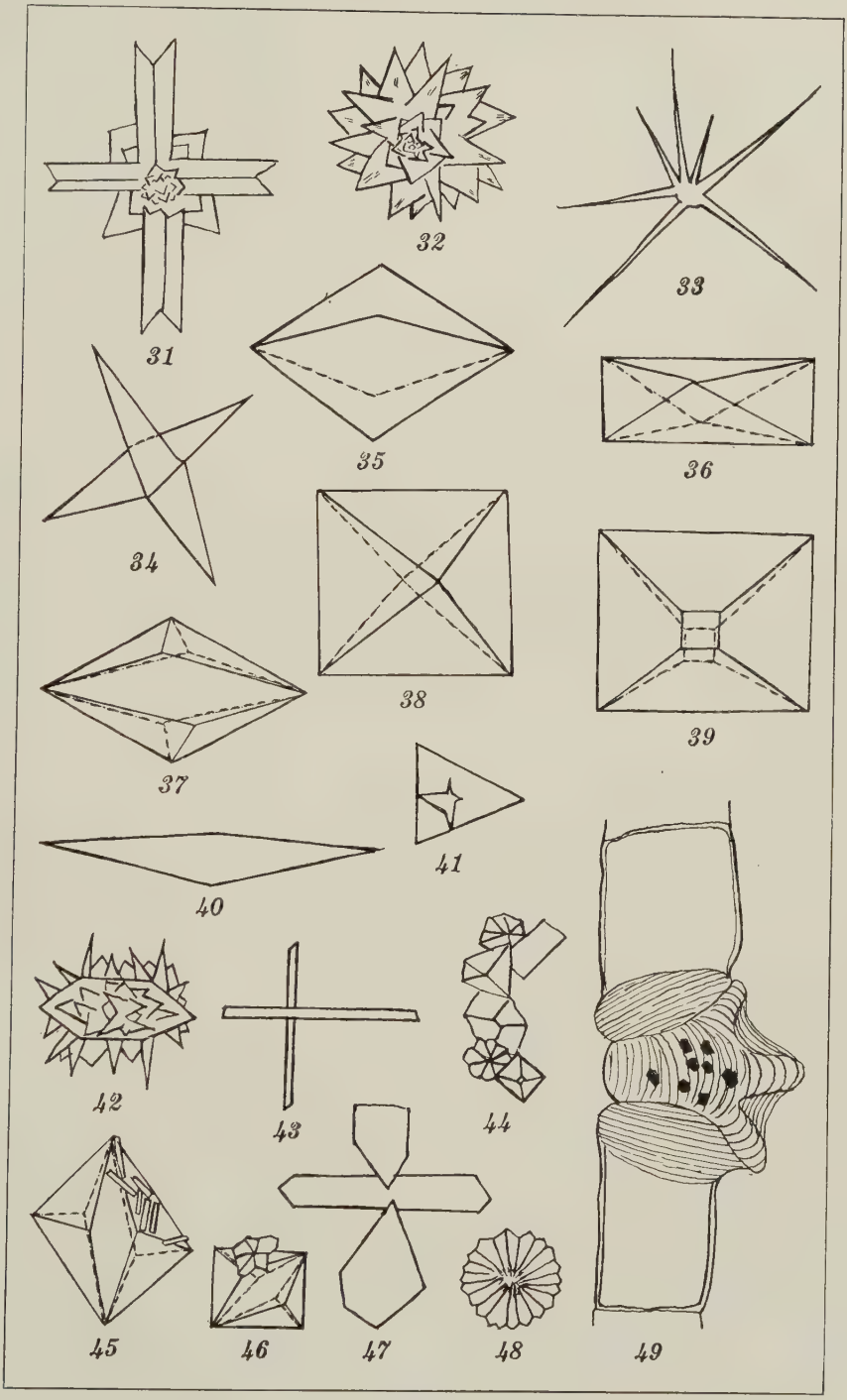


PLATE 6.

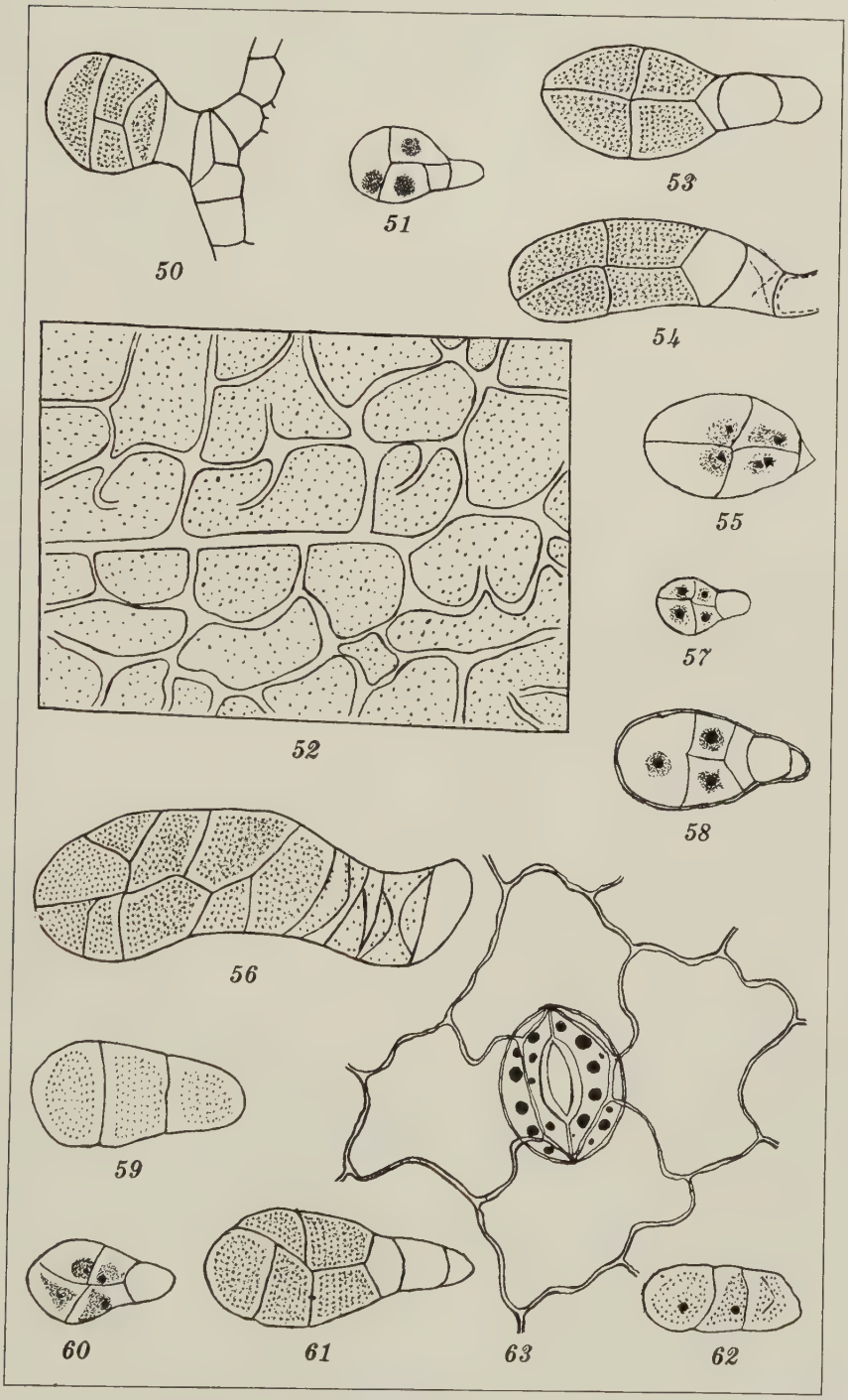
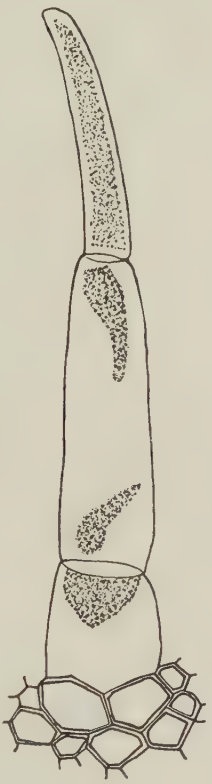
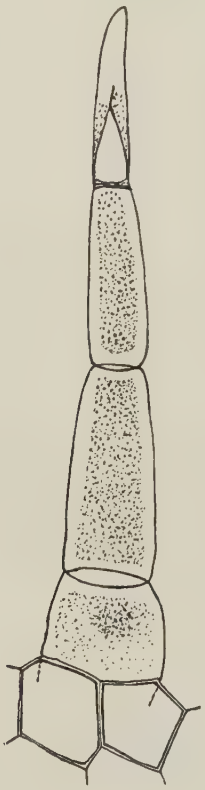


PLATE 7.

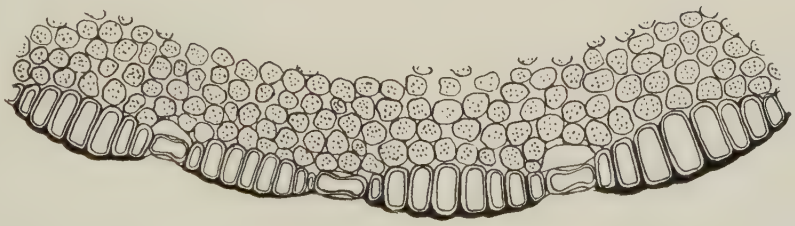


64

65



66



67

PLATE 8.

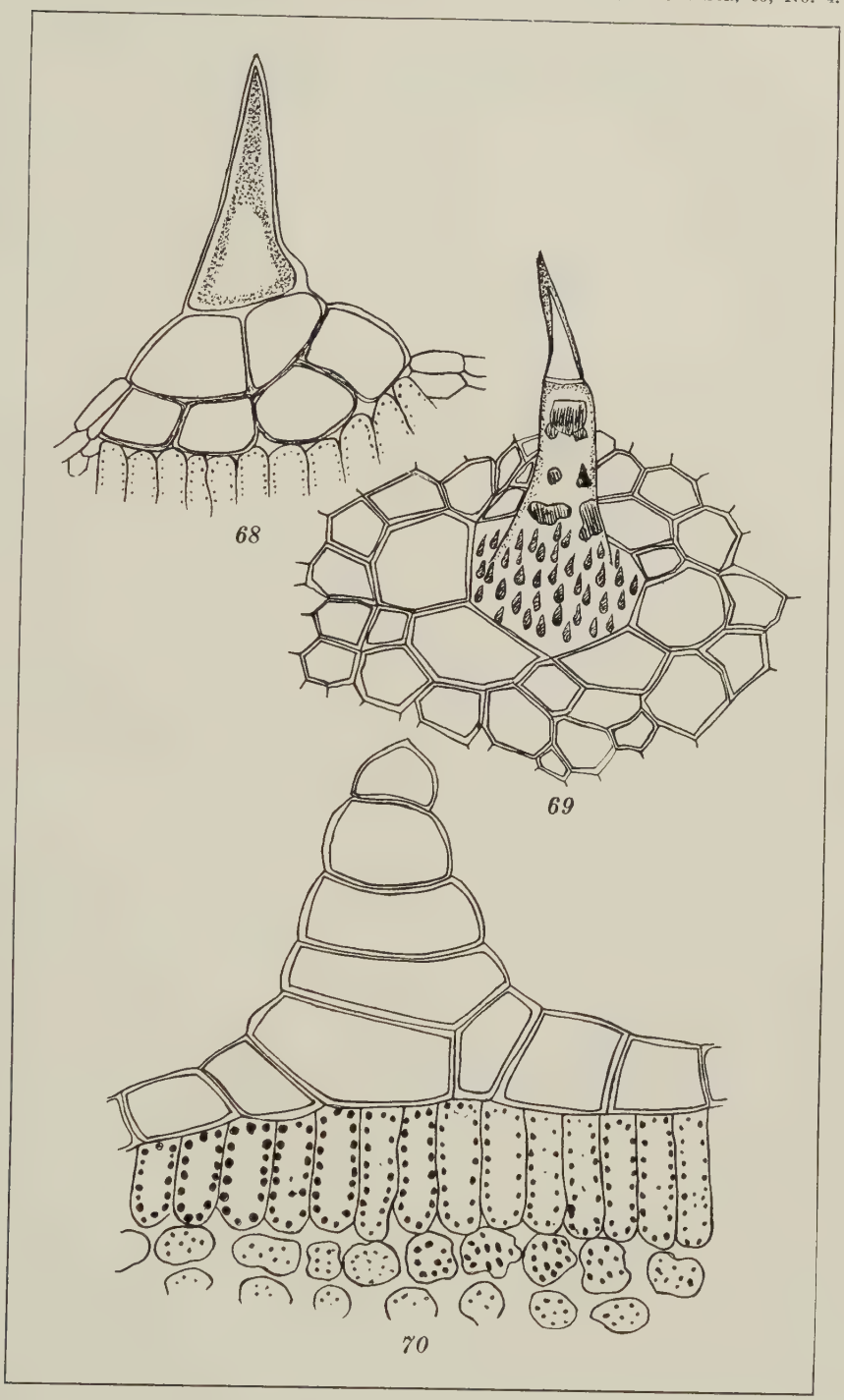


PLATE 9.

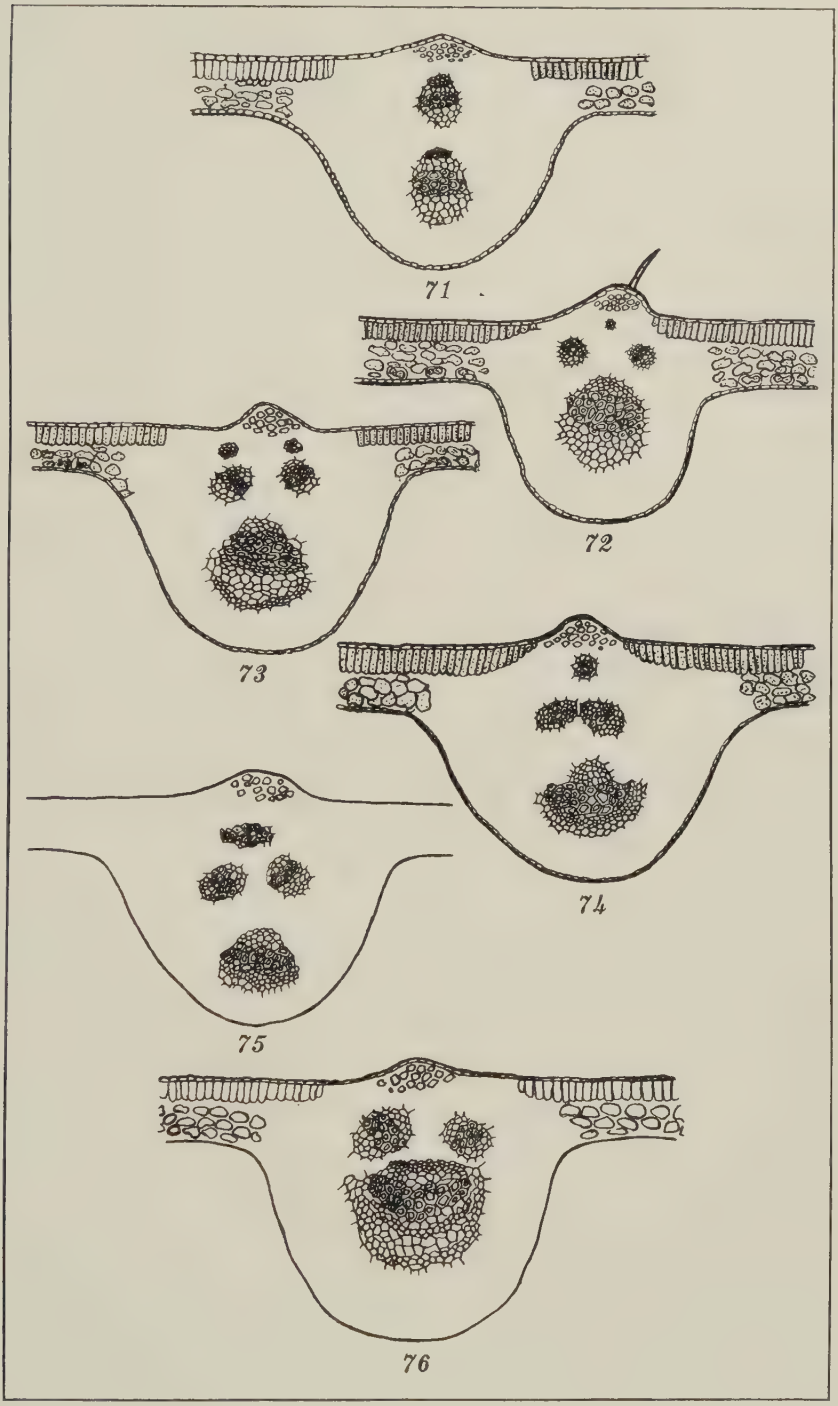


PLATE 10.

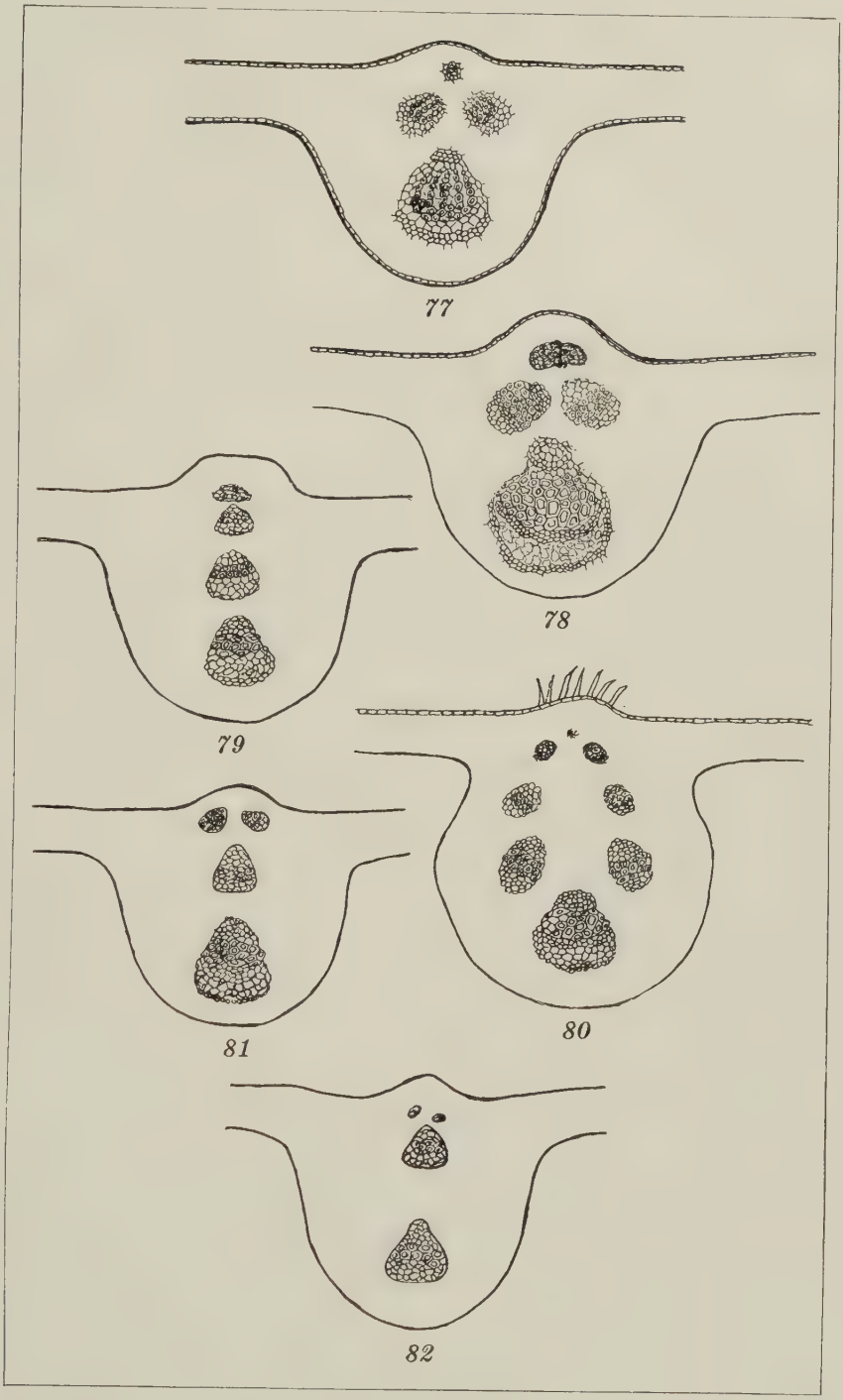


PLATE 11.

FRESH-WATER FISH FARMING IN THE PHILIPPINES

By Hilario A. Roxas and Agustin F. Umali
Of the Fish and Game Administration, Bureau of Science, Manila

TEN PLATES AND ELEVEN TEXT FIGURES

INTRODUCTION

The artificial propagation of fishes is not at all unknown to the Filipinos. In the bañgos industry the small fry are cultivated to a marketable size, an undertaking that necessitates the investment of large sums of money for considerable lengths of time. Extensive mangrove swamps and fore-shore lowlands have been adapted to such purposes, in Luzon and in many of the Visayan islands. These bañgos fish farms, however, are more or less brackish-water fishponds in which an adequate supply of sea or brackish water from an adjacent tidal stream is of paramount importance.

In interior regions, to which brackish or sea water has no access, the artificial culture of fish is not carried on. Yet the absence of fresh-water fish farming in the Philippines cannot be attributed to lack of adequate sites, for the Philippines is abundantly supplied with fresh-water streams. Perhaps it is traceable more to the absence of a native edible fresh-water species that is profitable to raise in such confined spaces as are to be found in regularly-constructed fish farms. Our fresh-water fishes, as the murrel, *Ophicephalus striatus* Bloch; the climbing perch, *Anabas testudineus* (Bloch); the fresh-water catfishes, *Clarias* spp.; and the fresh-water eels, *Anguilla* spp. are all deficient in one or the other of the different characteristics essential in fishes for artificial cultivation. Even our marine species, as the milkfish, *Chanos chanos* (Forskål), and the mullets, *Mugil* spp., that could live in fresh water, are unprofitable to culture in fresh-water ponds, where the growth of algæ, the bulk of the food of these two species, is entirely inadequate to supply their needs for rapid growth.

Numerous attempts to cultivate the above-mentioned species have been total failures, not because of mismanagement or faulty technic, but because of the inability of these native fishes

to thrive and multiply properly in confinement in limited bodies of water. Up to the present the supply of such fresh-water species in the market is taken from natural grounds, where no attention whatsoever is paid to their proper growth and multiplication. They are left to themselves, nature taking her own course, the survival of the fittest being the only governing law.

INTRODUCTION AND DISTRIBUTION OF IMPORTED FOOD FISHES

Because of the inadequacy of the native fresh-water fish resources, the Bureau of Science, through the Fish and Game Administration, has for several years endeavored to import foreign species, both for replenishing the natural supply of fresh-water species in our lakes and streams and for cultivation in artificial fresh-water ponds. Such species as the black bass, *Huro floridana* (Le Sueur); the carp, *Cyprinus carpio* Linnæus; the catfish, *Haustor catus* (Linnæus); and the giant goramy, *Osphronemus goramy* Lacépède have been imported at different periods for this purpose.

Black bass.—This fish was imported from Folsom, California, by A. Seale, May 4, 1907, when he brought 175 fingerlings, 7 of which died in transit. This original lot was planted in a lake near Pines Hotel and in Trinidad Lake, Baguio, Mountain Province. Table 1 is the summary of the distribution of black bass in the Philippines.

TABLE 1.—*Distribution of black bass in the Philippines.*

Date.	Locality.	Number.	Length.
----------	Cayman Lake, Los Baños, Laguna	----------	----------
Dec. 17, 1913	Los Baños, Laguna (private pond)	----------	----------
Dec. 22, 1913	Lake Lanao, Mindanao	50	----------
Jan. 1915	Lake near Kiangan, Ifugao	----------	----------
Oct. 28, 1916	Lake Sampaloc, San Pablo, Laguna	1 tank	----------
Nov. 1916	Lake Lanao, Mindanao	8 cans	fry
Jan. 1925	Tributaries of Lake Lanao	----------	----------

In the Philippines black bass have so far failed to spawn in the lowlands, although they have been breeding in great numbers in Baguio where the temperature is low. For this reason their cultivation has never been popular in the Islands.

Carp.—The first batch of carp was introduced from Hongkong into the Philippines in 1915, also by A. Seale, through the then Colonial Secretary, Claud Severn, for the Philippine Government, when 2,000 fry in 15 cans were requested for the Depart-

ment of Mindanao and Sulu for stocking the swamp lakes of Cotabato.

The second batch was introduced by Dr. A. W. Herre from Canton, April 9, 1925. Presumably these were the Cantonese carp with proportionately large bellies.

The third batch, apparently the Formosan variety with a slenderer body, was brought by H. R. Montalban from Formosa in February, 1926. Table 2 is the summary of the distribution of carp in the Philippines.

TABLE 2.—*Distribution of carp in the Philippines.*

Date.	Locality.	Number.	Length.
Feb. 1915	Swamp lakes of Cotabato	2,000	fry
Oct. 1916	Lanao (not Lake Lanao)		
Nov. 18, 1918	Lakes Dapao and Nunungan		
June 4, 1926	Laguna de Bay, Luzon	400	
June 11, 1926	Lakes Buhi and Bato, Camarines Sur	300	
Aug. 9, 1926	Lake Baao, Camarines Sur	150	
Feb. 1927	Umingan, Pangasinan		
Mar. 30, 1927	Lake Paoay, Ilocos Norte	300	
June 5, 1927	Laguna de Bay, and Magat River, Nueva Vizcaya		
July 11, 1927	Rio Grande de Pampanga and Santa Ana, Pampanga	300	
July 4, 1928	Laguna de Bay	400	
July 7, 1928	do	400	
July 28, 1928	do		

Carp is now very numerous in Lanao and Bicol Provinces, and in Laguna Province, where it has replaced the native species to some extent. It does not require cultivation in regularly constructed farms, because it can compete with the various native species. It now forms the bulk of cheap food fish in the Bicol provinces.

Catfish.—The catfish was only very recently imported by W. Adams, who, January 10, 1935, brought from San Jose, California, 96 specimens, which varied in length from 13 to 31 centimeters and had not yet reproduced. At the time of writing these are still quartered in one of the compartments of the Bureau of Science Propagation Ponds.

Goramy.—In September, 1927, Dr. A. W. Herre arrived in Manila with a little over 700 goramy, both young and adult. These were bought from one Hadji Hanapi,[1] chief citizen of a village of the Javanese town of Pasar Minggu. The records of the Bureau of Science show that of this number, 40 were planted in Laguna de Bay, July 7, 1927, and 200 were introduced in Lake

[1] Asia 29 (1929) 210, 211, 236, 238, 239.

Bato, June 27, 1928. The remainder of this batch were quartered in the Manila Propagation Ponds, where they were observed to have spawned for the first time in the latter part of March, 1930, when fry varying from 4 to 8 centimeters in length were seen in nursery tank No. 4 (text fig. 1). From October, 1930, the distribution of goramy has been brisk, as can be seen from Table 3.

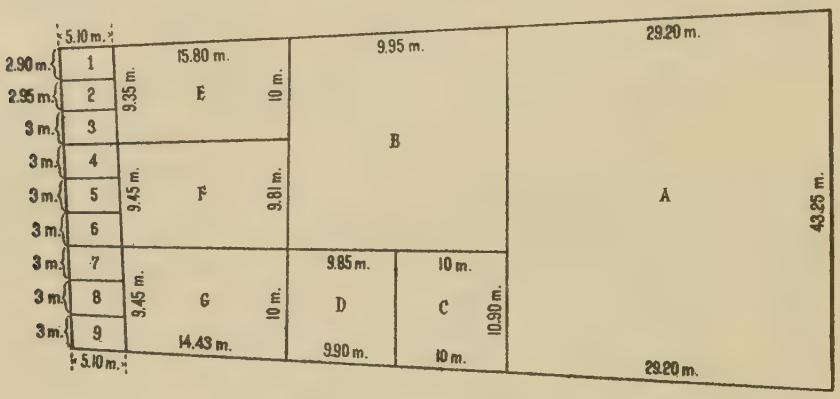


FIG. 1. Ground plan of the Manila Propagation Ponds of the Bureau of Science.

Although at the time of writing goramy have been observed to propagate in lakes and streams (Lake Bato and its inlets, Agus and Libon Rivers and their outlet, Bicol River), they are best fitted for culture in regularly constructed ponds, where their breeding and growth may be properly promoted and safeguarded. Being essentially vegetarians, they are devoid of strong and sharp dentition that may serve as a protection against the native carnivorous species. As such, they are easy preys to the predacious fishes that abound in our bodies of fresh water.

The tables show that of the different species imported, the goramy is most in demand for cultivation. This is perhaps due to the following characteristics, which make it thoroughly amenable to pond culture:

1. It is herbivorous, hence the problem of food supply is easily solved.

2. It is nonpredacious and noncannibalistic, hence the yield is not greatly reduced even under crowded conditions.

3. It readily breeds in confinement, hence there is no need of stocking the pond from year to year with new fry.

4. Its flavor and eating qualities are equal, if not superior, to that of the native species generally eaten.

TABLE 3.—*Distribution of goramy in the Philippines.*

Date.	Locality.[a]	Number.	Length.
			cm.
July 7, 1927	Laguna de Bay	40	
June 27, 1928	Lake Bato, Camarines Sur	200	
Oct. 8, 1930	Los Baños, Laguna	40	13
Nov. 7, 1930	Sorsogon, Sorsogon	15	13
Dec. 6, 1930	Los Baños, Laguna	20	13
June 17, 1931	San Jose, Nueva Ecija	3	25–31
Oct. 28, 1931	Camp Nichols, Rizal	6	15
Dec. 23, 1931	Angeles, Pampanga	57	8–31
Dec. 23, 1931	San Jose, Nueva Ecija	10	8–15
Mar. 17, 1932	Angeles, Pampanga	12	10
Apr. 9, 1932	Dalirig, Bukidnon	24	10–18
May 21, 1932	Angeles, Pampanga	12	8–10
June 11, 1932	Lagangilang, Abra	30	5–23
June 15, 1932	Dalirig, Bukidnon	15	5–10
June 25, 1932	Manila	12	3– 8
July 25, 1932	Angeles, Pampanga	117	5–41
Aug. 15, 1932	Lucban, Tayabas	24	5–10
Aug. 20, 1932	Dalirig, Bukidnon	15	5–15
Aug. 24, 1932	Mandaluyong, Rizal	20	10–15
Sept. 17, 1932	Malabon, Rizal	2	5–15
Nov. 25, 1932	Paete, Laguna	36	5–31
Nov. 27, 1932	Bangued, Abra	12	5–10
Mar. 1, 1933	Manila	4	5–10
Mar. 6, 1933	Davao Penal Colony, Davao	300	8–13
April 4, 1933	Calamba, Laguna	25	8–31
May 13, 1933	Cagayan, Misamis	20	10–15
May 27, 1933	Calamba, Laguna	25	10–31
Aug. 2, 1933	Tiaong, Tayabas	192	8–28
Aug. 12, 1933	Amboklas Bokad, Mountain Province	36	8–15
Aug. 12, 1933	Capiz, Capiz	25	10–23
Aug. 23, 1933	Cagayan, Misamis	46	8–13
Aug. 26, 1933	Manila	6	8
Sept. 9, 1933	Malolos, Bulacan	4	3– 8
Sept. 30, 1933	San Narciso, Zambales	12	10
Jan. 3, 1934	Tiaong, Tayabas	69	18–25
Jan. 6, 1934	Manila	4	10–20
Feb. 2, 1934	Sorsogon, Sorsogon	6	15
Feb. 5, 1934	Davao, Davao	13	15–20
Feb. 13, 1934	Iloilo, Iloilo	12	13
Feb. 13, 1934	Pasig, Rizal	12	10
Mar. 19, 1934	Manila	12	13
April 19, 1934	do	24	13–20
April 25, 1934	United States (exchange)	60	13–20
July 3, 1934	Bay, Laguna	26	13–31
Aug. 10, 1934	San Nicolas, Pangasinan	12	10–13
Aug. 20, 1934	Iwahig Penal Colony, Palawan	40	13–15
Sept. 4, 1934	La Carlota, Occidental Negros	12	13
Sept. 4, 1934	Manila	2	25
Sept. 28, 1934	Pasay, Rizal	12	13–28
Sept. 29, 1934	Umingan, Pangasinan	17	8–23
Oct. 1, 1934	La Carlota, Occidental Negros	7	13–28
Oct. 2, 1934	Umingan, Pangasinan	12	13
Oct. 6, 1934	Mexico, Pampanga	65	13–41
Oct. 9, 1934	San Jacinto, Pangasinan	8	10
Oct. 9, 1934	Manila	5	18–25
Oct. 9, 1934	Bacolod, Occidental Negros	24	13–23
Oct. 30, 1934	Nangpicuan, Nueva Ecija	30	13–25
Oct. 30, 1934	Talisay, Occidental Negros	24	13–18

[a] The distribution was mostly by sale to private persons in the localities cited.

TABLE 3.—*Distribution of goramy in the Philippines*—Continued.

Date.	Locality.[a]	Number.	Length.
			cm.
Nov. 5, 1934	Dinalupihan, Bataan	28	23–31
Nov. 8, 1934	Manila	14	31–36
Nov. 12, 1934	Calasiao, Pangasinan	6	8–10
Nov. 27, 1934	Angeles, Pampanga	52	15–38
Dec. 12, 1934	Santa Rosa, Nueva Ecija	4	20–31
Dec. 17, 1934	Pilar, Bataan	24	13
Dec. 18, 1934	Talisay, Negros Occidental	12	13
Dec. 24, 1934	San Quintin, Pangasinan	12	13
Dec. 24, 1934	San Fabian, Pangasinan	6	13–20
Jan. 2, 1935	Manila	1	25
Jan. 12, 1935	Bacolod, Occidental Negros	24	13–15
Jan. 18, 1935	Sangangdaan, Rizal	12	18
Jan. 18, 1935	Pasay, Rizal	7	8
Jan. 29, 1935	Lipa, Batangas	57	8–31
Mar. 18, 1935	Macabebe, Pampanga	3	8–31
Mar. 22, 1935	Manila	1	31
Mar. 22, 1935	Maao, Occidental Negros	12	13–25
Mar. 22, 1935	Los Baños, Laguna	5	8–13
May 18, 1935	Balintawak, Rizal	30	10–43
May 20, 1935	Cotabato, Mindanao	12	13–20
May 27, 1935	Lucban, Tayabas	6	15–18
June 13, 1935	Cabuyao, Laguna	12	20–36
June 13, 1935	Pasig, Rizal	6	13–31
June 19, 1935	Pandacan, Manila	6	13–20
June 24, 1935	Cabuyao, Laguna	2	18
June 29, 1935	San Fernando, Pampanga	18	18–23
July 13, 1935	Manila	12	15–18
July 27, 1935	General Trias, Cavite	4	23
July 29, 1935	Mexico, Pampanga	4	28–31
Aug. 10, 1935	Manila	3	25
Aug. 15, 1935	Mexico, Pampanga	4	25–31
Aug. 20, 1935	Maao, Occidental Negros	12	18–31
Aug. 29, 1935	Mexico, Pampanga	39	18–56
Sept. 16, 1935	----do	2	10
Oct. 30, 1935	Manila	4	3– 5
Nov. 22, 1935	Occidental Negros	12	8–10
Nov. 22, 1935	San Juan, Rizal	13	5–31
Nov. 27, 1935	Minalin, Pampanga	12	33–46
Jan. 2, 1936	Cotabato, Cotabato	24	3–13
Jan. 8, 1936	Marikina, Rizal	12	5–10
Mar. 11, 1936	Nangpicuan, Nueva Ecija	6	31–36
Mar. 16, 1936	Manila	12	5–18
Mar. 25, 1936	Floridablanca, Pampanga	8	33–46
April 23, 1936	Manila	5	5–15
	Total	2,365	

[a] The distribution was mostly by sale to private persons in the localities cited.

5. It is a hardy fish, hence mortality during the period of growth is very small.

These good qualities are slightly minimized by the fact that the goramy is not as rapid a breeder as our native species. Nevertheless it is the one species, among imported as well as endemic fishes, that meets the approval of fishpond owners in

the Philippines. The description of its characteristics and the method of its culture is the purpose of the present work.

The Philippine Department of Agriculture and Commerce is at present planning to construct a series of fresh-water ponds in the interior regions, which are far from the sea and where the supply of fish is low. In Nueva Vizcaya and Isabela Provinces in Luzon, in the central portion of Panay and in the interior parts of Surigao, Agusan, Oriental and Occidental Misamis, Lanao, Cotabato, and Davao Provinces, sufficient acreage of goramy ponds may be profitably located to stabilize the fresh-water fish supply of these inland regions.

GORAMY

OSPHRONEMIDÆ

Goramy, also written gourami, gouramie, and gouramy, is the name given to a group of remarkable fresh-water labyrinthine fishes, with a deep and compressed body covered with moderate-sized scales that are regularly arranged. The small mouth is without teeth on the roof or palate. There is but one dorsal fin on the back. Characteristic of these fishes is the prolongation of the first ray of each ventral fin into a filament, which fin may consist of a spine and five soft rays or may be reduced to a single elongated ray and a rudimentary spine.

Like other labyrinthine fishes, it has a pair of labyrinthiform organs on the head, lying directly above the gill cavity, which serve as an accessory breathing apparatus, enabling the fish to absorb oxygen directly from the air and thus to survive outside of its natural habitat for some time, as well as to resist considerable pollution of the water.

Although there are many species of goramy, the majority do not attain a large enough size to be suitable for food. Most of them are of sizes that are good only for ornamental purposes, home pets with their interesting breeding habits and their pugnacity and beauty. Even in the Philippines the three-spotted goramy, *Trichogaster trichopterus* (Pallas), has been found to abound in a small crater lake in Cagayan Sulu. The giant goramy, *Osphronemus goramy* Lacépède, is the only one attaining a large size enough to make its cultivation for food profitable.

GIANT GORAMY

OSPHRONEMUS GORAMY Lacépède. Text figs. 2 and 3.

This goramy is a large fresh-water fish of Java, Madura, Sumatra, and Borneo in the Malay Archipelago. Some authori-

ties regard it as a native of Cochin China. It has been introduced as an aquarium fish into Europe and as a valuable food fish into Mauritius, Cayenne, and Australia in 1864, into Madras in 1886, into Ceylon in 1908, and into other places, including the Philippines.

Body characteristics.—This goramy reaches a length of 183 centimeters. As in other members of the goramy family, the body is deep, in large specimens nearly twice the length of the head. The snout is much produced and the head is with a distinct concavity on its rostrodorsal profile, just in front of the eyes, but convex behind the eyes, becoming more and more so with advancing age. In the male this hump is prominent. With age the lower jaw seems to protrude in front of the upper.

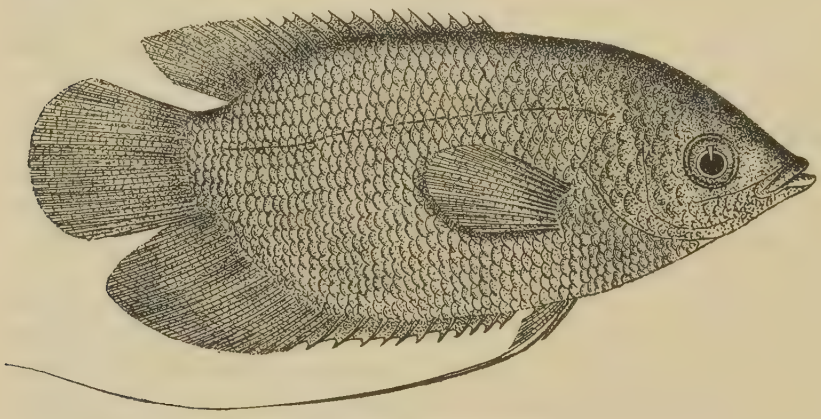


FIG 2. An adult female goramy.

The single dorsal fin has from 11 to 13 spines, and from 11 to 12 articulated rays, beginning behind the base of the pectoral fins. The very much longer anal fin has from 9 to 12 spines and from 19 to 21 branched rays. The caudal fin is rounded. The ventral fin, consisting of 5 soft rays and 1 spine is characterized by the very much elongated first ray, this being produced into a filament extending backward even beyond the end of the tail. The scales are regularly arranged and the lateral line is complete and continuous from the shoulder to the base of the caudal fin. The edge of the gill cover is smooth, without spines or serrations. The jaws are with fixed conical teeth and the roof of the mouth is toothless.

The adult is more or less grayish, olivaceous above, silvery or yellowish below, with the fins all dusky. In youth, the color

in life is gray, darker on the back and head. About 10 dark brown bands cross the body, the first just behind the edge of the gill cover and the last at the base of the tail. A black circular spot is visible towards the anterior border of the caudal peduncle, a little below the lateral line and on the second to the last band. A blackish spot is present at the base of the pectoral. All fins are dusky, edged with white. The posterior two-thirds of the tail is hyaline.

Albino specimens are not infrequently met with; in these the body and fins are creamy, the belly somewhat pinkish. In youth, the body is a beautiful combination of olive and orange or gold.

The eating quality of the giant goramy is excellent. The light yellow, straw-colored flesh, which is firm and easy of digestion, is of superior taste. The goramy has been praised for the excellence of its flesh and has always been held in high

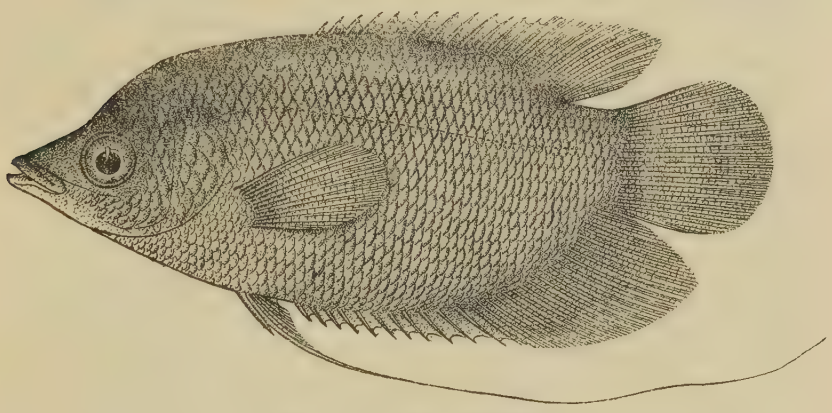


FIG. 3. An adult male goramy.

esteem by both Europeans and the natives of Java. In the Philippines all that have eaten it are unanimous in their praise and appreciation of its exquisite flavor, which compares favorably with that of the famed sea bass, *Lates calcarifer* (Bloch). The giant goramy is most adaptable to pond culture, because it is capable of attaining the gigantic size of 183 centimeters and a weight of 50 kilograms,[2] although the largest so far recorded in the artificial concrete ponds of the Bureau of Science is only 61 centimeters long, from the tip of the snout to the end of the tail. Moreover, it is essentially vegetarian, and therefore neither predacious nor cannibalistic; it is able to breed in

[2] Rept. U. S. Bureau of Fisheries. Report of the Commissioner for 1872 and 1873 pt. II, pp. 712.

artificial or regularly constructed fishponds; it can survive extreme pollution, and, last but not least, the flavor of its flesh makes it one of the best fresh-water species in cultivation.

LIFE HISTORY OF THE GIANT GORAMY

Breeding—Under normal conditions the giant goramy reaches sexual maturity and may be expected to breed after the fourth year. In some artificial ponds, where environmental conditions are not normal, this period is considerably longer. The goramy is over 30 centimeters long when it reaches breeding stage.

The female is generally with its belly enlarged or bulging because of the eggs, which number from about 500 to 1,000 in a moderate-sized individual. The male, as in the other members of the group, is usually distinguishable by its greater pugnacity, biting or fighting other males that interfere with its mating or pairing, especially during the breeding period. But more distinctive is the very pronounced hump on the nape of the male, being somewhat lower and less defined in the females.

In the Philippines, and under the conditions obtaining in the artificial concrete ponds of the Bureau of Science, where the bottom is muddy, the water stagnant, the temperature at the surface ranging from 27° C. to 32° C., and where there is no vegetation except patches of water hyacinths [*Eichornia crassipes* (Martius)], confined along the sides by means of a wire stretched taut, the giant goramy breeds the year round, although the peak of the breeding season occurs during the warm months, from March to May.

On spawning, the goramy pair off, and each pair selects a suitable place along the sides of the tank just beneath and along the edges of the patches of water plants. The vegetation preferred is an aquatic plant that grows on the surface of the water and whose floating roots, which rise and fall with the surface of the water, form natural galleries under which the fish can conceal themselves from public gaze and disturbance.

In the pond, among the water hyacinths and a little below the surface of the water (text fig. 4), the goramy attaches its nest. The nest is composed of plants, mud, and other available floating or submerged materials. Its shape varies from somewhat spherical to oval, and in form it resembles those of some birds. Table 4 summarizes the features of nests A, B, and C, all of which were actually recovered from goramy ponds in the Philippines. Nests A and B are shown in Plate 1, figs. 1 and 2.

FIG. 4. The nest of goramy in situ.

The size of the nest varies with that of the fishes, while the materials of which it is built depend upon whatever is procurable in the feeding or spawning ponds. It takes about a week for the goramy to build its nest.

TABLE 4.—*Summarized features of goramy nests recovered from ponds in the Philippines.*

Nest.	Date recovered.	Locality.	Measurements.			Contents.	Composition.
			Length.	Width.	Depth.		
			cm.	*cm.*	*cm.*		
A	Nov. 10, 1932	Manila Propagation Ponds.	30	18	9	Remnants of unfertilized eggs that have become decayed, soft, and mossy.	Roots, stalks, and leaves of water hyacinths; rattan; vines for tying kangkong, the feed of the fish; stalks of *Hydrilla verticillata*; mud.
B	Aug. 16, 1935	----do----	28	20	10	Newly hatched fry, with yolk sacs and some decayed unfertilized eggs.	Mostly roots, stalks, and leaves of water hyacinths, with scatterings of mud.
C	Oct. 19, 1935	Mexico, Pampanga.	28	26	10	Unrecorded-------	Grasses and twigs made compact and somewhat woven with roots of grasses and some wire, and pasted with mud.

When the nest is completed, the female deposits her eggs in the center of it. The eggs are round, shading from orange to yellow, and about 1 millimeter in diameter. After the eggs have been deposited and fertilized, the parents remain near, patiently aërating them by the constant fanning movements of the pectoral fins and zealously guarding them from predators and enemies.

The eggs hatch in about 10 days. Plate 2, figs. 1 to 4, shows various stages in the development and metamorphosis of the fry, from the time the individual is newly hatched until it reaches the age of 1 month and 12 days, when the appearance and shape of the adult become evident, and when the first ray of the ventral fin is distinctly beginning to prolong. The young find refuge in the nest during the first days of their life, under the protection of their parents; they do not soon disperse, but keep together in schools under the guidance of the parent fish.

Dr. A. W. Herre[3] describes the culture of the giant goramy in Java as follows:

[3] Asia 29 (1929) 210, 211, 213, 236, 238, 239.

In their fourth year a few large fish are placed in a breeding pond, in the ratio of two males to ten females. When their breeding time approaches, they make nests of the water plants growing in the pond. A close watch is kept, and, as soon as the eggs are laid and fertilized, they are transferred, nest and all, to large, wide-mouthed unglazed jars partly filled with water. These jars are left floating along the margins of the breeding-pond, either in some shady nook or else with a cover of palm-fronds. The eggs hatch in about 10 days, but the minute fry are left in the jars for a week longer. Eggs and fry are thus protected from all enemies and have a much better chance for life.

When the tiny fry are removed from the floating jars, they are first placed in small, shallow ponds, and for a number of weeks thereafter are fed upon a very strange diet. This is nothing less than the helpless, savory, soft-bodied young and workers of termites.

. . . At Garut the Javanese manage things quite differently from the Sundanese gurami-breeders in the lowlands. When the breeding fish are four years old, they are placed in comparatively large ponds about five feet deep. In due time they complete their nest and spawn. The eggs, however, are not transferred but are kept in the original pond, where they hatch in about ten days. The fry are given no special care but left solely to the protection of their parents. There is none of the forced feeding common in the ponds about Passar Minggu or Buitenzorg; the fry feed entirely upon the minute animal and vegetable life occurring naturally in the ponds. Consequently they grow more slowly, but they seem to be more vigorous.

The two methods were tried in the Manila Propagation Ponds, and it was found that the latter is the more desirable one, because the probability of pairing is increased when a greater number of individuals are mixed together in one pond. Due to the difficulty of distinguishing between the sexes, the segregation of the spawners, such that there will be a good ratio between males and females, is quite impossible and impractical.

TABLE 5.—*Goramy stock planted and offspring recovered in the Manila Propagation Ponds.*

Tank No.	Stock planted.			Offspring recovered.			
	Date.	No.	Length.	Date.	No.	Total.	Length.
			cm.				*cm.*
2	Aug. 8, 1930	10	36	Mar. 9, 1932	5	22	11
				July 16, 1932	17		10–20
4	Aug. 1, 1930	10	36	Aug. 27, 1931	------	85	(a)
				Dec. 23, 1931	2		10
				Mar. 17, 1932	12		11
				Apr. 9, 1932	4		11
				May 21, 1932	12		8–10
				June 15, 1932	55		10–23
5	Sept. 18, 1930	10	36	Dec. 23, 1931	32	123	8
				Apr. 9, 1932	3		11
				June 14, 1932	88		3–20

[a] Eggs.

Table 5 contains the data of the breeding recorded in the different nursery tanks of the Manila Propagation Ponds (text fig. 1), in which the segregation method was employed, although the young were left to the care of the parent fish. The breeding stock used was unassorted; that is, the proportion of the males to the females was undetermined, because of the difficulty encountered in ascertaining the sexes in this fish.

September, 1927, large tanks Nos. A and B in the Manila Propagation Ponds were planted with 343 and 91 young and adult goramy, respectively. The first spawns were observed in the summer of 1931. Table 6 shows the results of spawning in these two tanks.

TABLE 6.—*Goramy stock planted and offspring recovered in tanks A and B, Manila Propagation Ponds.*

Tank No.	Stock planted.				Offspring recovered.			
	Date.	No.	Length.	Total.	Date.	No.	Length.	Total.
			cm.				*cm.*	
A	Sept. 19, 1927	13	Adult	347	Dec. 23, 1931	5	8	1454
	do	101	Young		June 9, 1932	40	3–14	
	July 23, 1928	233	do		June 10, 1932	397	3–14	
					June 11, 1932	20	3–14	
					June 15, 1932	10	3–14	
					July 20, 1932	7	3–14	
					July 25, 1932	93	5–15	
					Aug. 2, 1932	19	5–10	
					Aug. 4, 1932	32	5–10	
					Aug. 9, 1932	15	15	
					Aug. 11, 1932	27	15	
					Aug. 20, 1932	9	15	
					Nov. 22, 1932	62	5–10	
					Nov. 25, 1932	24	5–15	
					Nov. 27, 1932	12	5–10	
					Dec. 1, 1932	33	3–14	
					Jan. 22, 1933	13	5–10	
					Mar. 1, 1933	4	5–10	
					Mar. 6, 1933	247	8–13	
					Apr. 12, 1933	6	8–13	
					Apr. 1933	10	5– 8	
					Jan. 3, 1934	76	18–25	
					Nov. 4, 1934	126	13–20	
					Nov. 7, 1934	113	8–25	
					Dec. 20, 1934	50	8	
B	Sept. 1927	72	Adult	91	June 10, 1932	17	3–10	390
	Aug. 25, 1930	1	36		Aug. 15, 1932	68	5–10	
	June 7, 1932	10	36		Aug. 16, 1932	22	5–15	
	June 8, 1932	8	36		Aug. 20, 1932	6	5–10	
					Dec. 1, 1932	36	5–10	
					Aug. 12, 1933	101	8–13	
					Feb. 2, 1934	50	15	
					Feb. 13, 1934	60	10–20	
					Dec. 20, 1934	30	10	

From a total of 438 individuals allowed to spawn in large ponds, 334 of which were young when planted in 1927 and 1928, 1844 offspring were recovered. Even when the age of the stock in the second case is disregarded, the ratio of offspring recovered to the parent fish is 1: 3.5 by the segregation method and 1: 4.2 when the fishes were allowed to mix at random in large ponds.

Feeding.—The macerated vegetable matter of which the nest is partly composed forms the earliest and most suitable food of the young. When they disperse, it is advisable to segregate them from the parent fish in order that they may not have to compete with the adults for food.

The giant goramy are omnivorous, feeding on flesh, fish, frogs, insects, worms, and many kinds of vegetables; they are, however, essentially vegetarian, and are especially fond of the leaves of aquatic or semiaquatic plants. For the first two or three months of their existence the young may be fed twice or three times a week with young termites and with other insects. As they grow older, they will subsist upon the leaves of *Hydrilla, Naias, Potamogon, kangkong, gabi,* cabbage, radish, lettuce, and similar plants. They also take potatoes, corn, camote leaves, arrowroot, bread, and the like.

They are extremely voracious feeders, so much so that a supply of 40 kilograms of kangkong fed the 400 adults and about 2,000 young in the Manila Propagation Ponds does not last 15 minutes. Both the leaves and the hard stalks are eaten up. Given this vegetable feed in abundance, they grow much faster and reproduce in greater numbers.

Age, growth, and development.—The rate of growth of the goramy depends upon the peculiarity of the individual, the amount of food given, and the space and the depth of water inhabited by the fishes. The following are the results of observation on the early growth and development of the gray variety of goramy grown in an indoor aquarium with a capacity of about 1 cubic meter of water.

Newly hatched fry (*Plate 2, fig. 1*).—A newly hatched fry is about 9 millimeters long, the body being somewhat elongate. The head measures 5 times in the total length, while the eye is contained 3 times in the length of the head. The yolk sac is still present. Although somewhat short, the caudal fin is fully formed. Only the beginnings of the soft dorsal and anal fins are evident as fleshy projections, there being as yet no distinct ray formation. The pectoral and the ventral fins are entirely absent, although fleshy indications of the former are already

visible. The pigmentations are still wanting except as scattered patches in some portions of the head and body.

Fry 15 days old (*Plate 2, fig. 2*).—The fry is now 10.8 millimeters long, with the body becoming deeper. The head is contained 4 times in the total length, while the eye is 2.5 in the head. The remnants of the yolk sac are hardly distinguishable. The caudal fin has become longer, while the dorsal and anal, which have also grown longer, have their rays fully discernible. The pectoral and ventral fins are still undeveloped. The pigmentation on the head and body are more visible, with the traces of the bands across the body somewhat outlined.

Fry 26 days old (*Plate 2, fig. 3*).—The fry is now 14.5 millimeters long, the body having become very much deeper. The head is 3 times in the total length, while the eye is contained 2.5 times in the head. The opercular flap is developing and traces of the yolk sac have completely disappeared. The caudal and the soft or rayed portion of both the dorsal and anal fins are fully formed, the spinous portion of the last two fins beginning to be evident. The pectoral and ventral fins are now developed, the latter showing indications of the prolongation of its first ray.

The color is now darker and more fully scattered throughout the head, body, and portions of the vertical fins. The bands across the body are fully formed, with indications of the circular spot at the caudal peduncle.

Fry 1 month and 12 days old (*Plate 2, fig. 4*).—The individual is now an advanced fry, having reached 17 millimeters in total length, with the appearance of a regularly developed goramy fry as regards its coloration and proportion of the body, head, eyes, and fins. The head is 2.2 times in the total length, while the eyes are 2.5 in the head. The opercular flap is now fully formed. Although still low, the spinous dorsal and anal fins are more fully differentiated. The pectoral and ventral fins are completely formed, with the elongation of the first ray of the latter somewhat longer. The bands have become more pronounced with the circular spot on the eighth band located just below the lateral line in full view.

From this stage the fish grow into fingerlings and yearlings, the most pronounced change being the projection of the snout, the formation of a somewhat whitish band across the nape, and the disappearance of the bands across the body and the spot on the caudal peduncle, the body finally turning grayish in color,

and lastly, the pronounced elongation of the first ray of the ventral fin.

Table 7 shows the maximum sizes reached and the stage of development attained at different ages, as observed and measured from fishes grown in the rearing compartments of the Manila Propagation Ponds, with kangkong feed as the sole nourishment, the young feeding on the leaves while the adults feed on both the leaves and the stalks.

TABLE 7.—*Length and stage of development of goramy at different ages.*

Age.	Length.	Stage of development. [a]
	cm.	
4 months	10	Fingerling No. 3.
8 months	15	Fingerling No. 5.
1 year	23	Yearling.
2 years	31	Two-year-olds.
3 years	36	Three-year-olds.
4 years	43	Adults or spawners.

[a] California Fish and Game 14 No. 4 (1928) 308.

In Java, according to Doctor Herre, the goramy are usually harvested when they are 1 or 2 years old at most. Those that are fattened for the great hotels are kept for 4 or 5 years or even longer, when they are said to attain a weight of from 2.3 to 6.8 kilograms.

The comparative data on two adult goramy caught in the Manila Propagation Ponds shown in Table 8 give the size and weight of goramy grown in the Philippines.

TABLE 8.—*Measurements of two goramy caught in the Manila Propagation Ponds.*

Serial No.	Length.		Depth.	Thickness.	Weight.
	Overall.	Standard.			
	cm.	*cm.*	*cm.*	*cm.*	*g.*
1	43	33	18	5.5	1,360
2	39	31	15	5	1,127

Under normal environmental conditions the giant goramy breeds at four years of age in these artificial ponds.

Diseases and enemies.—Like other species of fish that are cultured in artificial ponds, the giant goramy are attacked by such enemies in fishponds as the fish-eating birds and several species of water snakes and lizards.

Being essentially vegetarian, they are more apt to be preyed upon by such carnivorous fresh-water species as the murrel (*dalag*), the fresh-water catfish (*hitô*), and the climbing perch (*puyô*), and for this reason the supply and drain gates must be properly screened in order to prevent the entrance of predatory fishes and their eggs. The pond itself must be free from the above-mentioned species before it is stocked with goramy. The top minnows, such as the mosquito fish and the mollies, are spawn eaters and therefore a menace to the dispersing fry.

Unlike other delicate fishes reared in confinement in artificially constructed fish farms, the goramy are more free from the attacks of various fish diseases. However, in cases of extreme pollution and heating of the water, they also succumb. Careless handling and overheating of the containers during catching for transportation and in transit have been detrimental to the stock of many amateur fishpond owners, giving rise to attacks of fungus; when these attacks become advanced and extensive they are impossible to remedy and cure.

Instructions on the transportation and introduction of fish for culture (*text fig. 5*).—The following instructions are recommended to beginners to avoid unnecessary losses in the transportation of live fishes and their introduction into propagation ponds.

1. In transit:
   - *a.* The water should be removed partially or entirely from the container if it becomes fouled or smells badly, and replaced by fresh water of practically the same temperature.
   - *b.* The water should be aërated from time to time by dipping it and pouring it from a height. Care should be taken in dipping so as not to injure the fishes.
   - *c.* Heating by exposure to direct sunlight or in any other manner must be avoided.
   - *d.* Dead fish must be removed immediately.
   - *e.* Feeding the fishes should not be attempted.
2. Upon arrival and before planting:
   - *a.* The approximate difference in temperature between the water in the container and that in the pond should be determined either by means of a thermometer or by merely feeling with the hand.
   - *b.* The temperature of the water in the container should be tempered by gradually adding water from the pond.
   - *c.* The can should be tilted into the pond and the fish liberated without handling.

In the successful transfer of live fish, three important factors must not be lost sight of: Cleanliness, temperature, and vigilance.

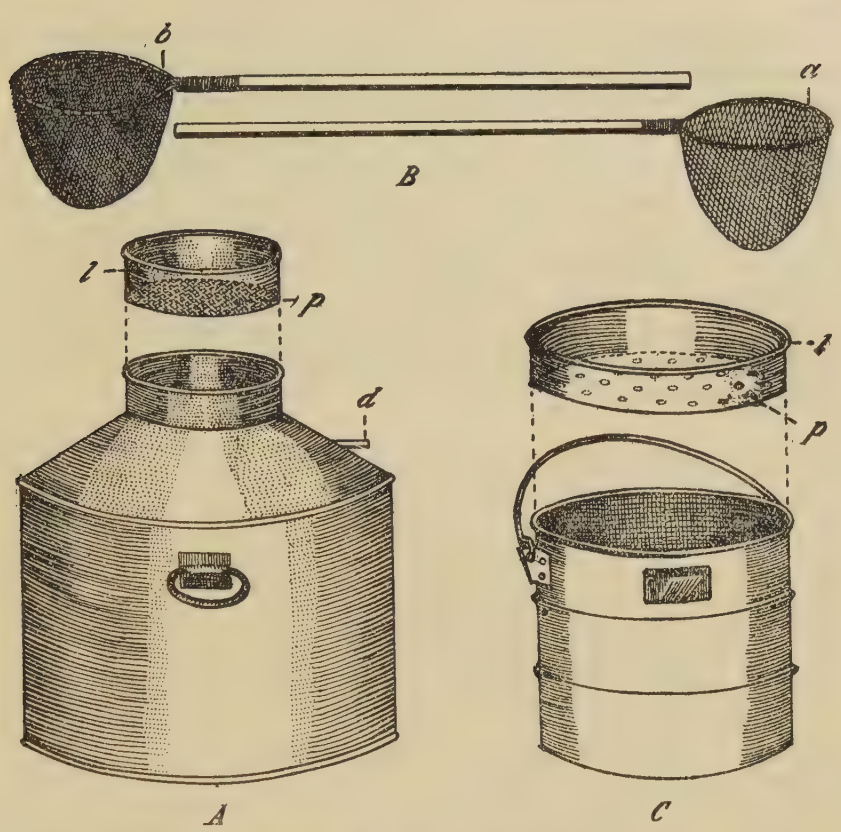


FIG. 5. Accessories in a fresh-water fish-culture establishment. *A*, Transportation can for adults: *d*, drain pipe of can; *l*, lid; *p*, perforated bottom of lid. *B*, Dip nets: *a*, coarse-meshed (for adults); *b*, fine-meshed (for young). *C*, Pail for young: *p*, perforated bottom of lid; *l*, lid of pail.

THE COMMERCIAL POSSIBILITIES OF THE GIANT GORAMY IN THE PHILIPPINES

As has been mentioned in the foregoing paragraphs, of the many native and foreign pond fishes the giant goramy is the only fresh-water species that has all the qualities and characteristics of a fish suitable, practical, and profitable for culture in fresh-water ponds.

Being a labyrinthine fish, like the murrel and the climbing perch, the giant goramy does not require a wide space for its cultivation. In Java, according to Doctor Herre, "some of them were mere isolated pools." They could even be cultured in backyards where a sufficient supply of water is available, and fed, like hogs, with kitchen off-fall, provided oil and lard are

not introduced into the pond. Little care is needed, besides that of maintaining enough volume of water, feeding the fish, and excluding, checking, or driving away their enemies.

Because of its superior flavor, this fish should be in good demand, especially in the interior regions, and during the stormy season when the supply of marine species is very much diminished. On the market it would probably be preferred to the bony milkfish, for, besides being free from small troublesome bones, the goramy has the desirable flavor of first-class marine species. It should, therefore, be very much in demand with the big hotels and restaurants in Manila, a city with a fish-eating population.

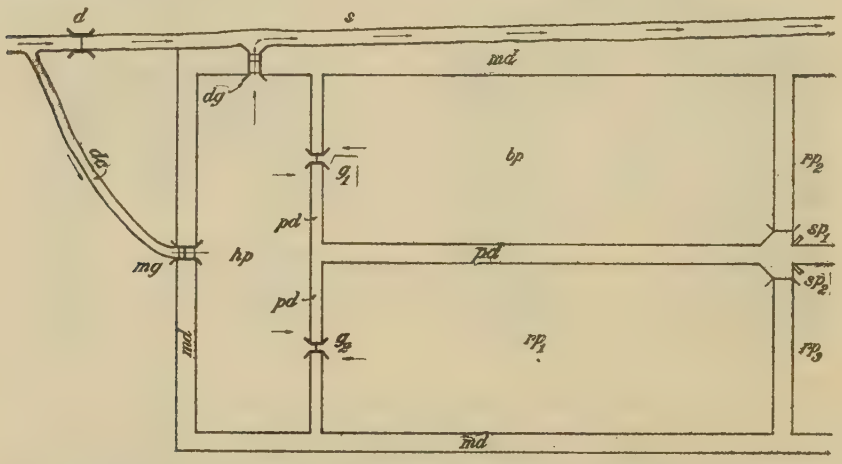


FIG. 6. A goramy pond system at Mabalacat, Pampanga. *S*, Stream; *hp*, head pond; *bp*, breeding pond; rp_1, rp_2, rp_3, rearing ponds; *d*, dam; *dc*, diversion canal, *md*, main dike; *pd*, partition dikes; *mg*, main gate; *dg*, drain gate; g_1, g_2, gates; sp_1, sp_2, supply pipes. The arrows point in the direction of the flow of water.

The ability of the goramy to breed in the ponds could furnish the basis for two industries, fry raising and the raising of the marketable size for the fresh-fish markets. A proprietor proficient in breeding and rearing the fry and selling them to large fishpond owners for transplantation into their larger ponds would surely net a good income, in much the same way as the Malabon fishpond owners engaged in the selling of bañgos fingerlings to fishpond owners of Bulacan and Pampanga (text fig. 6) earn a fair margin on their investment, in spite of the added expense incurred in the purchase of the tiny *kawag-kawag*, or bañgos fry.

The following is the approximate data on the commercial possibilities of a giant goramy venture. The maximum capitaliza-

tion and the minimum income have been used in the computations. For convenience, the figures used are all in round numbers.

	Pesos.
I. Probable capitalization:	
A. 1 hectare of fishpond site	200
B. Development of site	1,500
C. Fluid capital	300
Total	2,000
II. Probable expenses (annual):	
A. Maintenance:	
1. Wages (1 laborer at 20 pesos per month)	240
2. Supplies	50
3. Repairs	60
B. Fixed charges:	
1. Interest on capital, 10 per cent	200
2. Land tax, .0087 per cent of assessed value (200 pesos)	2
C. Sales charges:	
1. Sales tax, 1.5 per cent of sales	23
2. Bad debts, 1.5 per cent of sales	23
3. Marketing, 8 per cent of selling price	120
Total	718
III. Probable gross income (annual):	
Sale of 5,000 marketable fish (1-year- to 2-year-olds) at 30 centavos each	1,500
IV. Operating expenses (Item II)	718
V. Probable net income:	
39.1 per cent of the total capitalization	782

FRESH-WATER POND CONSTRUCTION

Although goramy is a hardy fish and could be cultured in scattered and isolated small backyard ponds, as has been observed by Doctor Herre in Java, cultivation in regularly constructed farms, where the volume of water and the proportion of plant to fish life are all under complete control, will result in considerable improvement in goramy raising. While the isolated and the haphazardly constructed fishponds are sometimes satisfactory, they are subject to the danger of insufficient water supply during extreme droughts and of drainage of the excess water during floods. Enough precaution and care must be observed in the selection of a site for such a project, in much the same way as a merchant or any other businessman considers the various factors before he decides on the final location of his enterprise, in order to avoid discouragement and collapse of

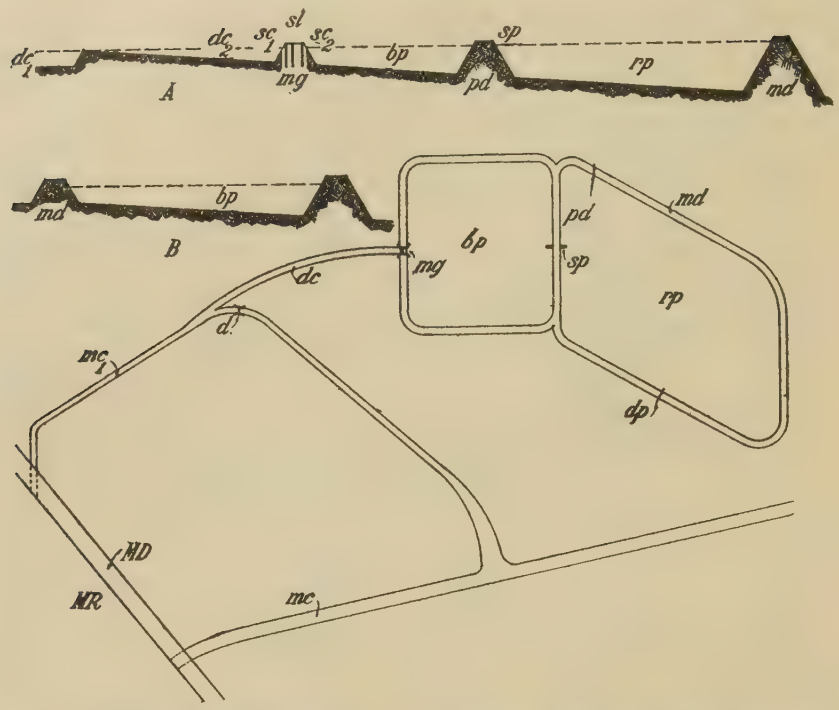


FIG. 7. Plan of the Molino Goramy pond. *A*, *B*, Sectional views; *MR*, Molino Reservoir; *MD*, Molino Dam; *mc*, main canal; mc_1, minor canal of *MR*; *d*, dam for pond; *dc*, diversion canal; *dp*, drain pipe (rubber siphon); *mg*, main gate; *md*, main dike; *sp*, supply pipe; sc_1, fine-meshed wire screen; sc_2, coarse-meshed wire screen; *sl*, wooden slabs; *bp*, breeding pond; *rp*, rearing pond; *pd*, partition dikes.

what might have been a very lucrative business. It is better that no such enterprise be undertaken as a passing fancy, for then it will result in unnecessary loss of money and energy. The fish-raising industry is one of the few undertakings that require patience, care, and perseverance, not only for a short period of time but for several years, in order to yield their best results, both in experience and technic, and in increased earnings for every peso of capital invested.

Three important factors must, therefore, be considered; the selection of the site for the pond, correct procedure, technic, and practice in construction, and the investment of enough energy and money so as not to sacrifice correct practice to stinginess. If all of these factors are strictly observed, barring unforeseen circumstances, there is no reason for such a venture proving a failure.

SELECTION AND LOCATION OF THE POND SITE

Area and topography.—For the profitable cultivation of goramy on a commercial basis, a site of not less than a hectare should be selected. A smaller site would be impractical to divide into the various compartments needed in the pond system, and would not allow space for the house, garden, and small farm of the caretaker. The farm should be dedicated to the raising of feed of the fishes. The site must be free from inundation and surface drainage, to avoid the flooding and washing out of the dikes and the resulting loss of fish and need for repairs. Many fish have been lost in floods by several goramy fishpond owners in Luzon because of faulty selection of the site, to the extent that even ordinary flood and surface waters are hard, if not impossible, to control.

Type of soil.—While any type of soil except sandy and rocky or other extremely porous soil will do for the construction of fresh-water fishponds, heavy clay, through which water cannot percolate, is the most desirable. A site in which the soil is of somewhat loose texture can be made water-tight by puddling it with clay. Sandy soil is impractical, for while the bottom may be puddled as above, the construction of earthen dikes that will remain intact and in form is a great problem, as the dikes are likely to collapse with very heavy rain. Moreover, it is difficult to haul such types of soil from the pond bottom to the site of the dike construction. An extremely rocky or gravelly soil is also impractical, as it gives rise to great expense in the excavation of the pond bottom, while the excavated materials will be useless in the construction of the dikes.

Water supply.—The availability of an adequate water supply is the most important factor to be considered before the construction of a pond is contemplated, for upon it depends the whole fate of the investment. The presence of water in a site is no guaranty that the pond will have sufficient water throughout the year. The volume of water needed is enough to fill the pond to sufficient depth to maintain the normal life of the goramy. That volume must be maintained through even the driest part of the year, so as to replace the amount that is lost in seepage and evaporation. In other words, the water supply must meet the exigencies of the most adverse conditions. Fish need to be in water all the time, or else they will perish. The source of the water must be properly investigated to determine whether the demands made upon it above the site will not endanger the

enterprise during some time of the year—demands for irrigation, and similar purposes. The study of the behavior of the level in the source is essential for the construction of the dam and the diversion canal in such a manner as to maintain a flow, so that whenever necessary all the different compartments of the fishpond can be flooded. The level of the head needs, therefore, to be determined by a competent engineer during the two extremes of the year with regards to the possibility of maintaining the desired volume in the various ponds of the system.

Nearness to market.—Although nearness to market is not as important as the other three factors mentioned, it needs to be looked into in order to determine the financial success of the enterprise. The advantage of being near a good market is obvious. There the produce can be disposed of with the least delay and a minimum of expense. The pond does not need to be near the market when there are adequate transportation facilities at hand, although transportation involves an additional item of expense that must be recovered in the higher price that the commodity should command in isolated places where the supply of fish is very limited.

Procedure of construction.—It is unwise to construct a pond system right in the course of a stream or a river, where the water cannot be controlled during freshets and is likely to cause damage to the embankments and dams. Even if the dikes and dams do not give way during high water, there is the difficulty of screening the pond and preventing the escape of the fish. The pond itself will become shallow, due to the gradual accumulation of sediments carried by these intermittent floods. Should it be found cheaper, and otherwise good policy, to build in this manner, an artificial ditch should be built at one side the whole length of the pond, to carry off surplus water.

The pond system (text fig. 11) must be built at one side of the stream by digging the ground and building dikes or embankments, and the water let into the compartments by a system of canals, pipes, and sluices (concrete or wooden-screened gates), and damming the stream at a point above the site and diverting a portion of the flow through a narrow diversion canal. The source of the water then available from the dammed portion of the stream must be high enough to water all the parts of the pond by the force of gravity.

Main dikes (*text fig. 8*).—Once the site of the pond system is found from all angles to conform to the conditions necessary, the next step is to lay out the plan of the main dikes. Inasmuch

as these structures may be considered the pillars of the fish-pond, they must be built as strong as possible in order to weather all climatic conditions prevailing in the locality.

The construction of the main embankments depends upon the topography of the land, the character of the soil, and the volume and pressure of the water to be confined. The place where the pressure of the water is greatest is the danger point in the pond system, requiring a safe dike 2 meters high, 6 meters thick at the base, and 1 meter thick at the top, the earth gradually sloping on the sides. This dike will be able to retain 1.5 meters depth of water. A safe proportion for such an embankment is a slope of 1.5 on the horizontal for 1 on the vertical towards the outside of the pond; while a grade of 1 to 1 must be maintained towards the inside. For the less-exposed portion of the pond, where the water pressure is correspondingly less, depend-

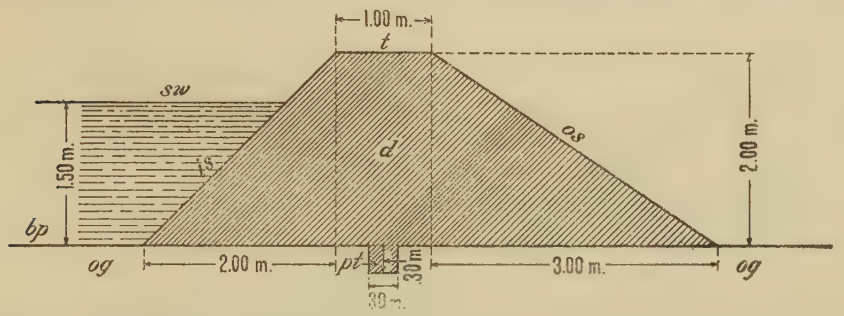


FIG. 8. Cross section of a portion of the main dike for the weak sections of the pond system, showing the slopes and the puddle trench. *sw*, Surface of water; *bp*, bottom of pond; *og*, original ground; *d*, dike; *is*, side of dike towards the inside; *t*, top of dike; *os*, side of dike towards the outside; *pt*, puddle trench.

ing upon the topography of the land, the main dikes may be built at varying strengths in the proportion set forth above.

Once the line for the construction is laid, the site should be cleared of all trees, including stumps, roots, underbrush, pieces of wood, and other organic matter that is likely to decay and possibly result in loss of water by seepage through these potential leaks in the construction.

Then a puddle trench should be dug, 30 centimeters wide, 30 centimeters deep, and extending the whole length of the main dikes into which the new earth will settle. This trench will form a break between the original ground and the construction, and increase the stability of the embankment. Without such a trench, the superficial junction between the damped earth and the surface ground is a natural weakness, giving rise to much seepage, especially in the case of elevated sites. The fillings

should progress by layers over the full length and width of the levee as a continuous operation rather than by sections, for otherwise the completed work will develop checks by reason of variations in materials and difference in compactness. Rocks and grasses with entwining roots are of use as a protecting riprap on the slope after completion. It has been found that corners in the form of arcs are more desirable than those with an angle of 90 degrees, because the latter are more rapidly eroded by waves created by the movement of the surface water striking the side at a sharp angle. Text fig. 8 is a cross section of the main dike, showing the correct slope.

The diversion dam and canal.—In view of the fact that the pond system needs to be constructed on the side of the supply stream, the diversion of a portion of the latter's flow into the various compartments necessitates the building of a diversion

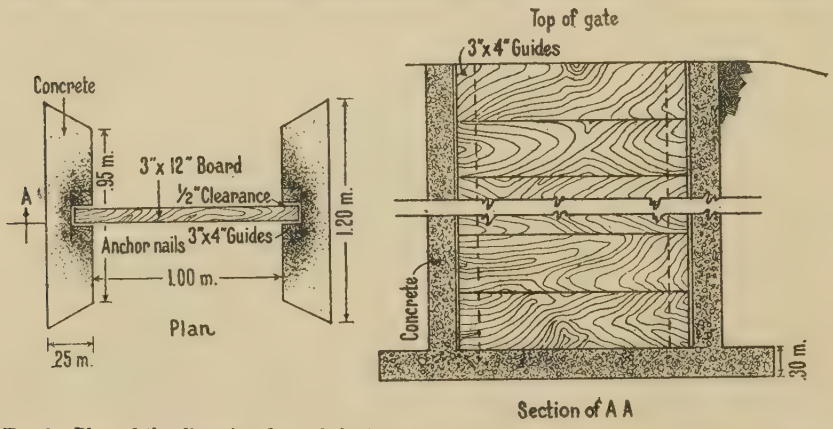


FIG. 9. Plan of the diversion dam of the Molino Goramy Pond, Bacoor, Cavite; diagrammatic.

dam and a diversion canal. A point where the stream or spring is narrowest and highest must be located above the pond, the former in order to reduce the cost of construction and the latter in order to flood any part of the system at least cost, through gravitation. This is accomplished by a system of removable flashboards, placed in the dam when water is desired and removed when water is not needed. Thus, while the pond can be flooded at will by diverting a portion of the flow of the streams, the danger of it being overflooded during freshets is obviated by simply removing the flashboards of the dam and allowing the stream water to flow through its natural course. Text fig. 9 is a plan of a diversion dam together with the details of its construction. Plate 7, figs. 1 and 2, shows the working of such a dam.

In the construction of the dam there must be built a sufficient thickness of concrete work along both sides of the bank, so that it will be able to resist the pressure of the water current when blocked. The flashboards must fit into wooden guide boards embedded into the concrete sides so as to avoid the breaking or chipping off of any portion of the concrete work. In order to maintain the volume of water in this dam when the ponds are to be flooded, the first flashboard must, likewise, fit into a wooden groove at the bed of the stream so as to form a water-tight inclosure. This device is especially useful during droughts, when the volume of flow in the supplying stream is very much diminished.

The diversion canal must not be dug as low as the bed of the stream; it must be constructed at least 30 centimeters higher in order to prevent the backing up of the flow once the dam is opened. From this point the canal must be dug in such a way that a gradual slope is maintained towards the pond system. The end towards the main gate of the pond must be about 30 centimeters higher than the bottom of the pond itself. A canal about ½ meter wide, with the depth varying with the topography of the site and in conformity with the conditions set forth above, is sufficient to supply the desired volume needed in the whole pond system. This canal should be screened at least at one, if not at both ends, by a screen purposely constructed at the end towards the stream and at the main gate towards the pond, to prevent the ascent of the cultivated species to the stream, and to keep undesirable fish and fish eggs and floating drift out of the pond system.

The gates.—With a view to safeguarding the pond from the entrance of enemies and to preventing the escape of the cultured fish, a well-built and properly screened main supply gate is essential. Text fig. 10 is the plan of a concrete main gate, together with the details of its construction.

Since the gate provides the main entrance of water from the outside, it needs to be located at the highest portion of the pond site that is adjacent to the diversion canal. From this point the general contour of the pond bottom must be gradually sloping down to the last compartment and to the deepest portion, where the main drain gate is to be built. The whole structure must be provided with three pairs of wooden guides, into the grooves of which will fit the fine-meshed wire screen, the wooden slabs, and the coarse-meshed wire screen, from outside to inside in the order enumerated. The fine-meshed screen is for

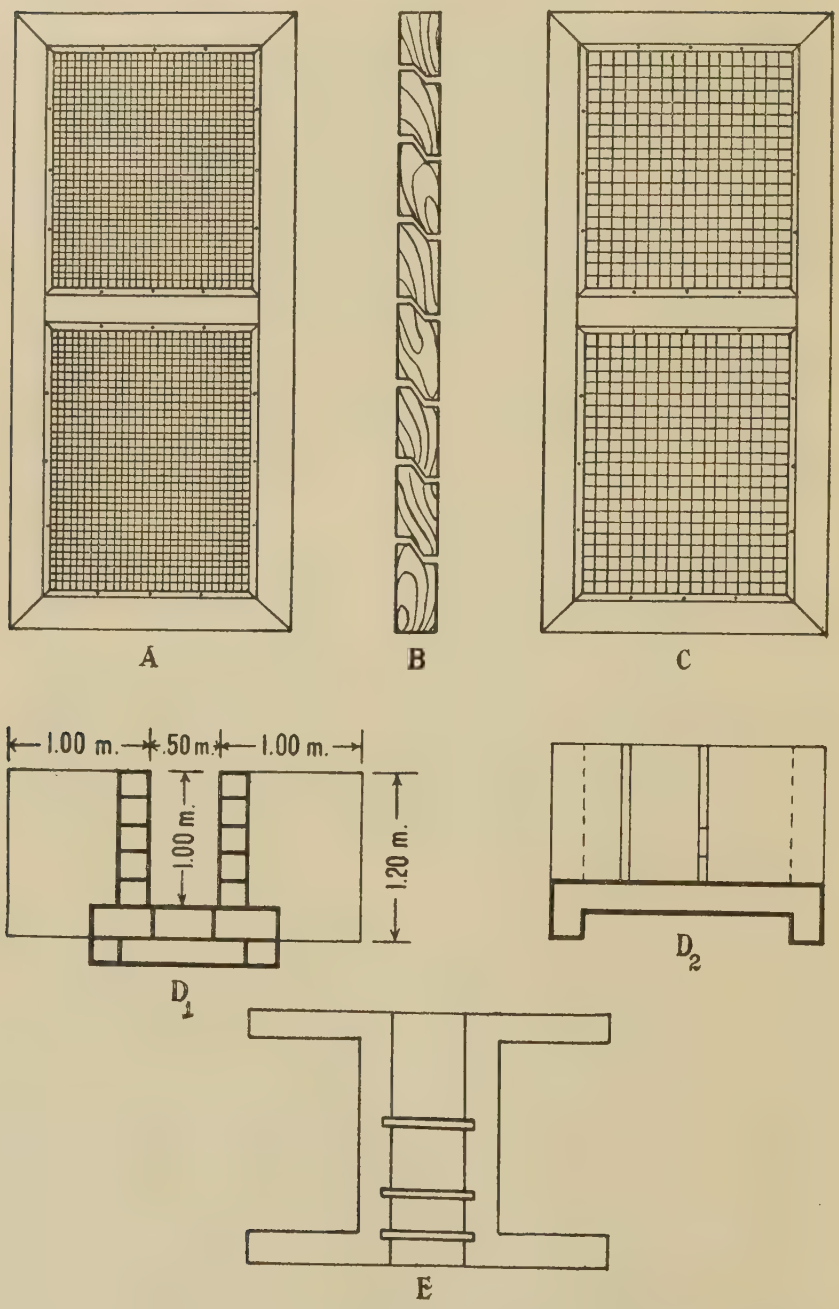


FIG. 10. A, Fine-meshed wire screen; B, groove arrangement of wooden slabs (cross section); C, coarse-meshed wire screen; D_1, D_2, sections of main gate; E, plan of main gate.

excluding all undesirable eggs and young of enemies; the wooden slabs are for retaining the water in the pond, especially in the head and in the supply and drain canal; the coarse-meshed screen is for preventing the cultured species from ascending the stream and crowding at the main supply gate, especially when water is let into the ponds.

Just as important as the main supply gate is the main drain gate, which, as stated above, must be situated at the lowest point of the pond system so as to effect complete drainage when desired. This device is also of use in lowering the level of the water in catching fish and in cleaning the compartments. The construction of such a gate is the same as in the main supply gate, except in the order in which the screens are placed; in this main drain gate the fine-meshed screen must be towards the inside of the pond, while the coarse-meshed screen is towards the outside. This reverse order is to check the escape of the eggs and young of the cultured species.

Besides the two main gates, partition gates need to be built for supplying water and at the same time for draining the different compartments as occasion demands. These do not need to be strong gates and may be built of wood only. Properly screened concrete, iron, or wooden pipes will also do for this purpose, but small wooden gates of similar design as the main gates are preferable.

Compartments.—To make the culture systematic, there arises the need of dividing the pond system into compartments by the construction of lower and narrower dikes, the partition dikes. As each compartment is to serve one definite purpose, if they are constructed independently of each other, trouble in one will not cause a disturbance in the other compartments, neither in supplying nor in draining off the water. This system is essential to avoid disturbance in the normal spawning in the breeding ponds and the bruises occurring in the undersized fishes that are mixed with the marketable groups in the rearing ponds. A farm outlay should consist of three units; namely, head ponds, breeding ponds, and rearing ponds.

Text fig. 11 is a ground plan of a model goramy farm, together with sections showing the contours of the pond bottom of the whole system.

The head pond.—This compartment must be adjacent to the main supply gate and, therefore, directly connected with the diversion canal. It must cover at least one per cent of the whole

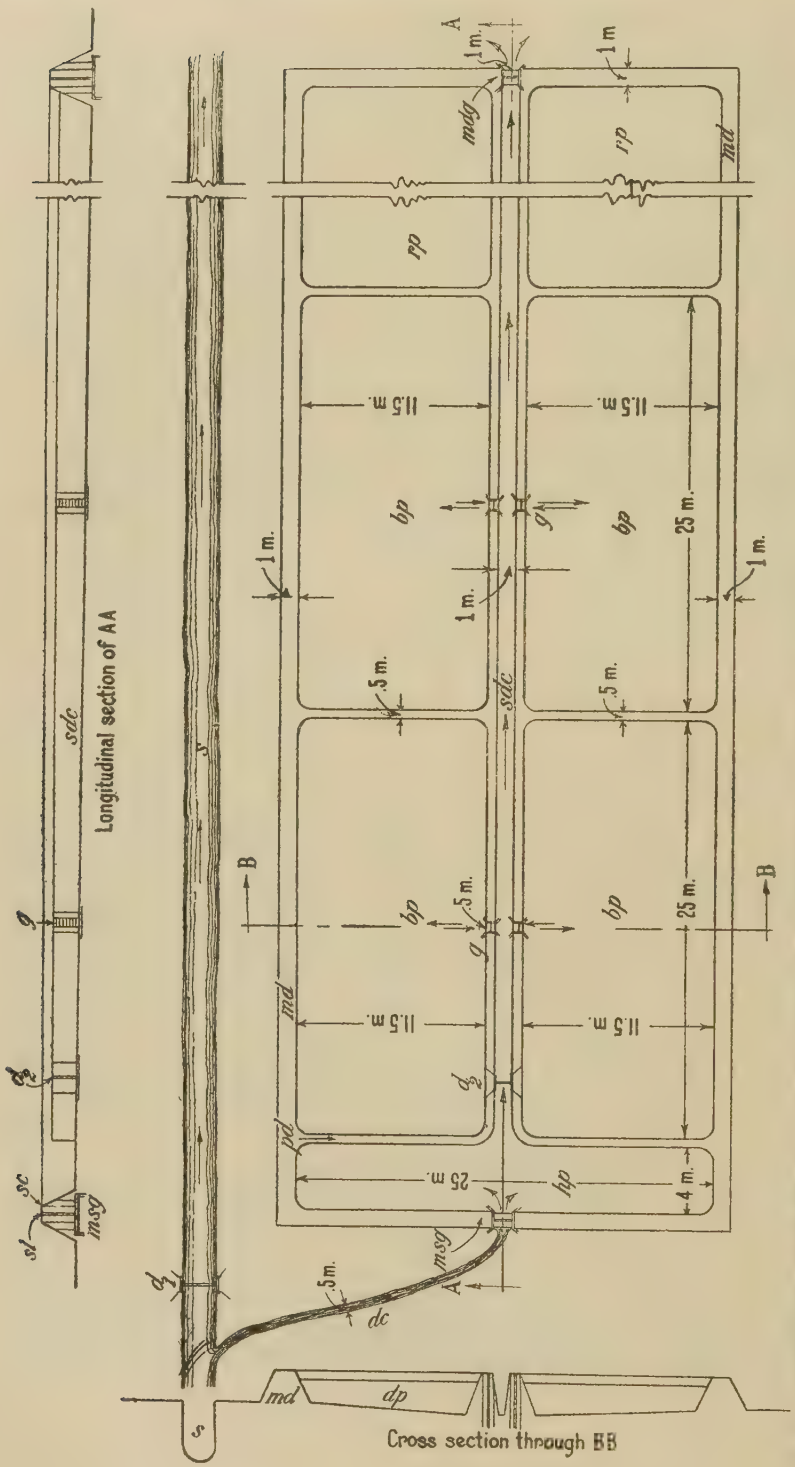


FIG. 11. Ground and sectional plans of a model goramy pond; diagrammatic. *s*, Stream; *hp*, head pond; *bp*, breeding pond; *rp*, rearing pond; d_1, diversion dam; d_2, dam of head pond; *dc*, diversion canal; *msg*, main supply gate; *md*, main dike; *pd*, partition dike; *sdc*, supply and drain canal; *g*, gate; *mdg*, main drain gate; *sc*, wire screens; *sl*, wooden slabs; arrow points in the direction of flow of water.

area of the pond site. This pond acts as a reservoir where the water can subside and breed plankton. The other divisions are constructed on both sides of a central canal, the supply and drain canal that leads from the head pond.

The breeding ponds.—The breeding ponds, otherwise known as the stock ponds, must cover an area of not less than 10 per cent of the entire site. At least two of such ponds must be built, so that when one is being cleared of the enemies of the species, the other can be used to accommodate the breeding stock.

In these ponds the spawners build their nests and breed. It must, therefore, be of sufficient depth (1.5 meters) so that the fishes can move about properly and enjoy a habitat approximating their natural state, conditions that are essential and conducive to proper spawning. Abundant growth of floating vegetation, the roots of which rise and fall with the level of the water, must be provided along the sides for the attachment of their nests and for supplying them with materials for nest building.

The rearing pond.—The remaining 89 per cent of the pond site may be converted partially or completely into rearing ponds, as the demand for quartering a greater number of offspring arises. These are compartments for the young once they are segregated from the parent fish, and serve also as nursery ponds, where the young can get the proper care until they reach a marketable size, when they are caught and marketed. The more rearing ponds there are in a pond system the better, for then the various sizes of young can be sorted and quartered separately. This provision will facilitate catching during marketing and cause the undersized to be spared from being unnecessarily bruised and injured. It will also afford the young the equal chances of feeding and growing that they would not have if young and old were mixed together in the same compartment.

As the breeding and rearing ponds are on both sides of the supply and drain canal, the bottom must slope down towards the latter so as to effect complete drainage when necessary.

After the whole pond site is completed and before it is filled with water, all roots, stumps, rocks, and everything that may prevent the free sweep of a net dragged along the bottom, must be removed.

As adjuncts to the pond system, a portion of the 89 per cent remaining may be set aside, after the head pond and the breeding ponds have been reserved, for the house of the caretaker and a small farm or garden where vegetables and other greens,

especially aquatic and semiaquatic plants, may be raised for the feed of the fishes.

Summarizing, therefore, the following are the areas that must be allotted to the different compartments in a 1-hectare fish-pond site:

Compartments.	Areas in sq m.	Per cent.
One head pond	100	1
Two or more breeding ponds	1000	10
Rearing ponds, house site, and farm	8900	89

APPROXIMATE COST OF CONSTRUCTING A 1-HECTARE GORAMY POND

The cost of construction depends upon several factors:

1. The topography of the land, whether level, sloping or undulating.
2. The type of soil, whether clay, mud, gravel, or rock.
3. The type of vegetation to be cleared, whether tall trees, shrubs, bushes, or grasses.
4. The cost of labor in the locality.

The following approximate cost is based on conditions obtaining in provinces near Manila, and in which the site is fairly clean and level:

Expenditures.	Pesos.
2 Diversion dams (concrete)	90
1 Main supply gate (concrete)	100
1 Main drain gate (concrete)	100
6 Partition gates (wooden)	60
Labor for the construction of main dikes Labor for the construction of partition dikes Labor for digging diversion canal	1000
1 House for caretaker	50
Tools, implements, and various accessories	100
Total	1500

DON'TS IN FRESH-WATER FISH FARMING

1. Do not begin a fresh-water fish farm without the necessary capital to complete the project.
2. Do not attempt to culture dalag, as it has been proven impractical and unprofitable to raise in captivity.
3. Do not mix noncarnivorous species with carnivorous ones in the same compartment.
4. Do not attempt to construct a pond where you are not certain of a reliable water supply the year round.
5. Do not locate your ponds in inundated sites or those where the soil is too sandy or rocky.

6. Do not dig your pond site deeper than necessary to maintain a sufficient depth of water after the dikes are completed; do not think that fishpond construction is all a question of digging.
7. Do not fill the finished or completed pond with water without clearing the bottom of obstructions so as to permit the free sweep of a net.
8. Do not undertake fishpond farming as a mere passing fancy.
9. Do not fail to replace your stock with new spawners after the old ones have reached "the point of diminishing returns" in the production of young.
10. Do not handle live fish with the dry bare hands; use a dip net or wet the hands before touching them.

ILLUSTRATIONS

PLATE 1

FIG. 1. Goramy nest recovered from the Manila Propagation Ponds, November 10, 1932.
2. Goramy nest recovered from a fishpond at Mexico, Pampanga, October 19, 1935.

PLATE 2

[The short (scale) line beside each figure represents 1 mm.]

FIG. 1. A newly hatched goramy fry.
2. A 15-day-old goramy fry.
3. A 26-day-old goramy fry.
4. Goramy fry 1 month and 12 days old.

PLATE 3

FIG. 1. Feeding goramy at the Manila Propagation Ponds. Note the fishes actually biting at the bundles of kangkong.
2. Bundles of kangkong scattered as feed in the goramy pond.
3. The bundles of kangkong in figure 2, 15 minutes after feeding.

PLATE 4

FIG. 1. Preparing the drag seine for catching goramy.
2. Dragging the seine in one of the concrete ponds.

PLATE 5

FIG. 1. Drag seine hauled in with adult and young goramy for transplantation.
2. Quarrying adobe rock at the bottom of the Molino Goramy Pond, Bacoor, Cavite.

PLATE 6

FIG. 1. Scraping soil from the bottom of the Molino Goramy Pond, Bacoor, Cavite.
2. Building the main dike of the Molino Goramy Pond, Bacoor, Cavite.

PLATE 7

FIG. 1. Closing the diversion dam to raise the level of the head water at the Molino Goramy Pond.
2. The diversion canal of the Molino Goramy Pond.

PLATE 8

FIG. 1. The main gate of the Molino Goramy Pond, showing the outer coarse-meshed and the inner fine-meshed wire screens.
2. The main gate of the Molino Goramy Pond, with the wire screens in place.

PLATE 9

FIG. 1. Letting water into the Molino Goramy Pond.
2. Close-up of a portion of the main dike of the Molino Goramy Pond.

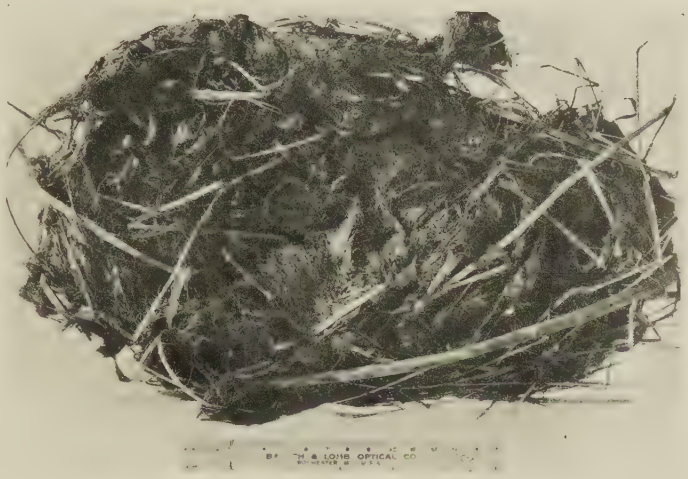
PLATE 10

FIG. 1. A completed compartment of the Molino Goramy Pond.
2. The Molino Goramy Pond system.

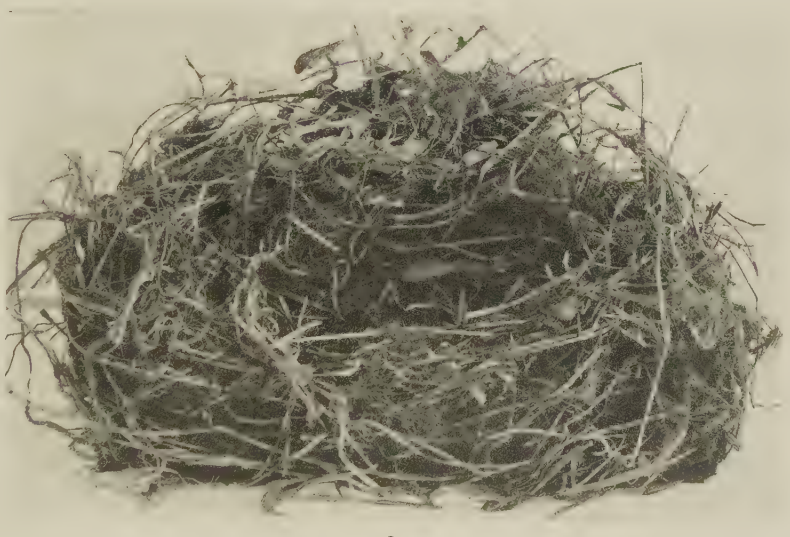
TEXT FIGURES

[Drawings by A. Verzosa.]

FIG. 1. Ground plan of the Manila Propagation Ponds of the Bureau of Science.
2. An adult female goramy.
3. An adult male goramy.
4. The nest of the goramy in situ.
5. Accessories in a fresh-water fish-cultural establishment. *A*, Transportation can for adults: *d*, drain pipe of can; *l*, lid; *p*, perforated bottom of lid. *B*, Dip nets: *a*, coarse-meshed (for adults); *b*, fine-meshed (for young). *C*, Pail for young: *p*, perforated bottom of lid; *l*, lid of pail.
6. A goramy pond system at Mabalacat, Pampanga. *s*, Stream; *hp*, head pond; *bp*, breeding pond; rp_1, rp_2, rp_3, rearing ponds; *d*, dam; *dc*, diversion canal; *md*, main dike; *pd*, partition dikes; *mg*, main gate; *dg*, drain gate; g_1, g_2, gates; sp_1, sp_2, supply pipes. The arrows point in the direction of the flow of water.
7. Plan of the Molino Goramy Pond. A, B, Sectional views; *MR*, Molino Reservoir; *MD*, Molino Dam; *mc*, main canal; mc_1, minor canal of *MR*; *d*, dam for pond; *dc*, diversion canal; *dp*, drain pipe (rubber siphon); *mg*, main gate; *md*, main dike; *sp*, supply pipe; sc_1, fine-meshed wire screen; sc_2, coarse-meshed wire screen; *sl*, wooden slabs; *bp*, breeding pond; *rp*, rearing pond; *pd*, partition dikes.
8. Cross section of a portion of the main dike for the weak sections of the pond system, showing the slopes and the puddle trench. *sw*, Surface of water; *bp*, bottom of pond; *og*, original ground; *d*, dike; *is*, side of dike towards the inside; *t*, top of dike; *os*, side of dike towards the outside; *pt*, puddle trench.
9. Plan of the diversion dam of the Molino Goramy Pond, Bacoor, Cavite; diagrammatic.
10. Molino Goramy Pond. *A*, Fine-meshed wire screen; *B*, groove arrangement of wooden slabs (cross section); *C*, coarse-meshed wire screen; D_1, D_2, sections of main gate; *E*, plan of main gate.
11. Ground and sectional plans of a model goramy pond; diagrammatic. *s*, Stream; *hp*, head pond; *bp*, breeding pond; *rp*, rearing pond; d_1, diversion dam; d_2, dam of head pond; *dc*, diversion canal; *msg*, main supply gate; *md*, main dike; *pd*, partition dike; *sdc*, supply and drain canal; *g*, gate; *mdg*, main drain gate; *sc*, wire screens; *sl*, wooden slabs. The arrow points in the direction of the flow of water.



1



2

PLATE 1.

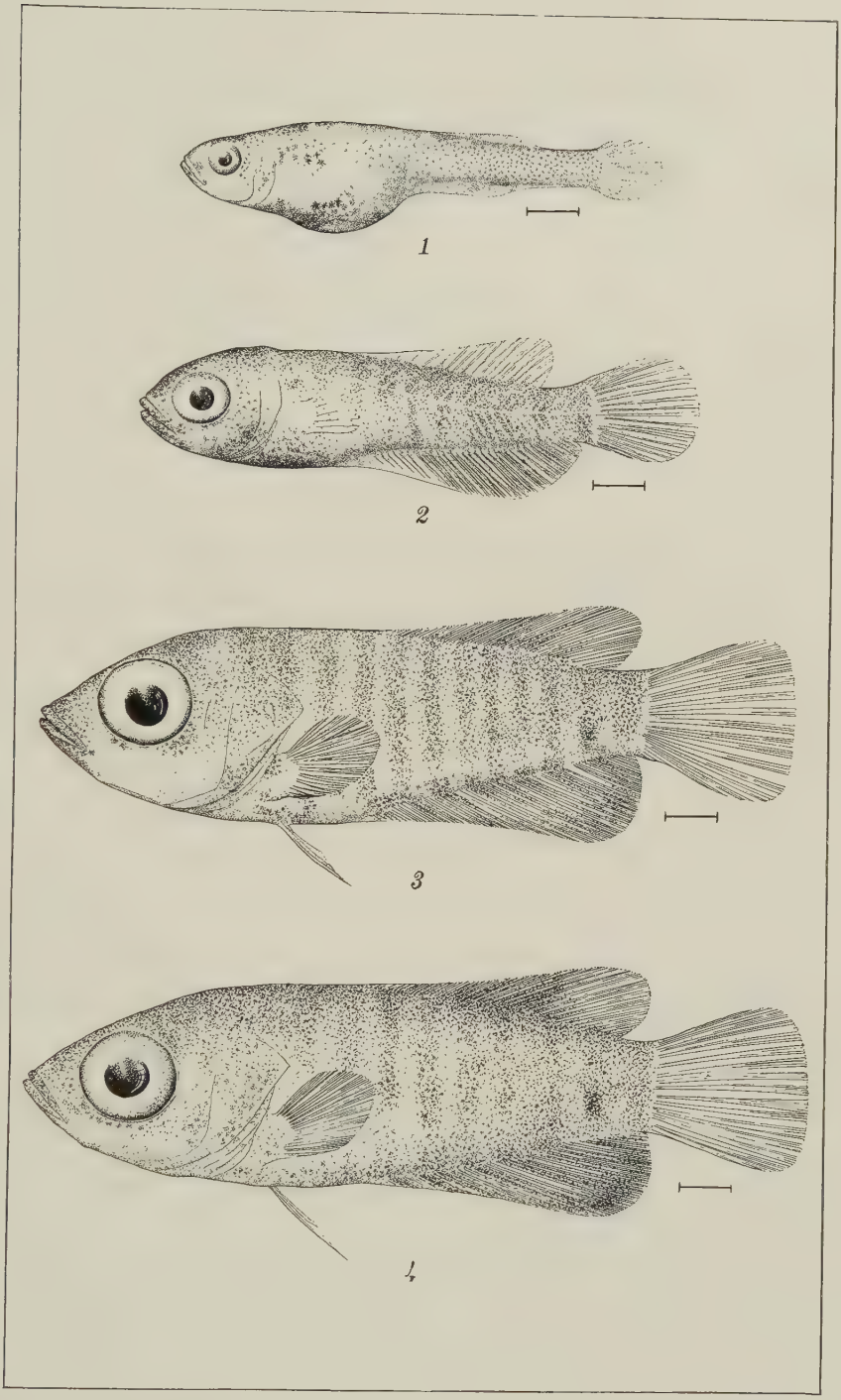
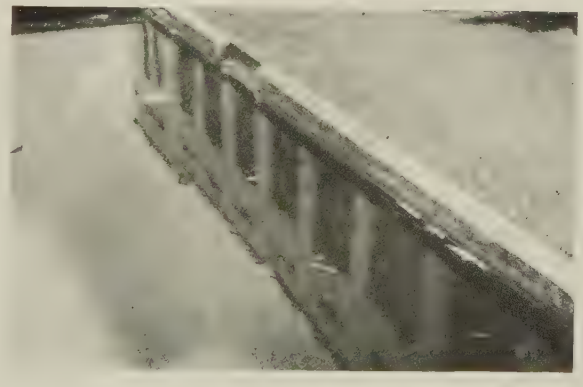


PLATE 2.

1

2



3

PLATE 3.

PLATE 4.

PLATE 5.

PLATE 6.

PLATE 7.

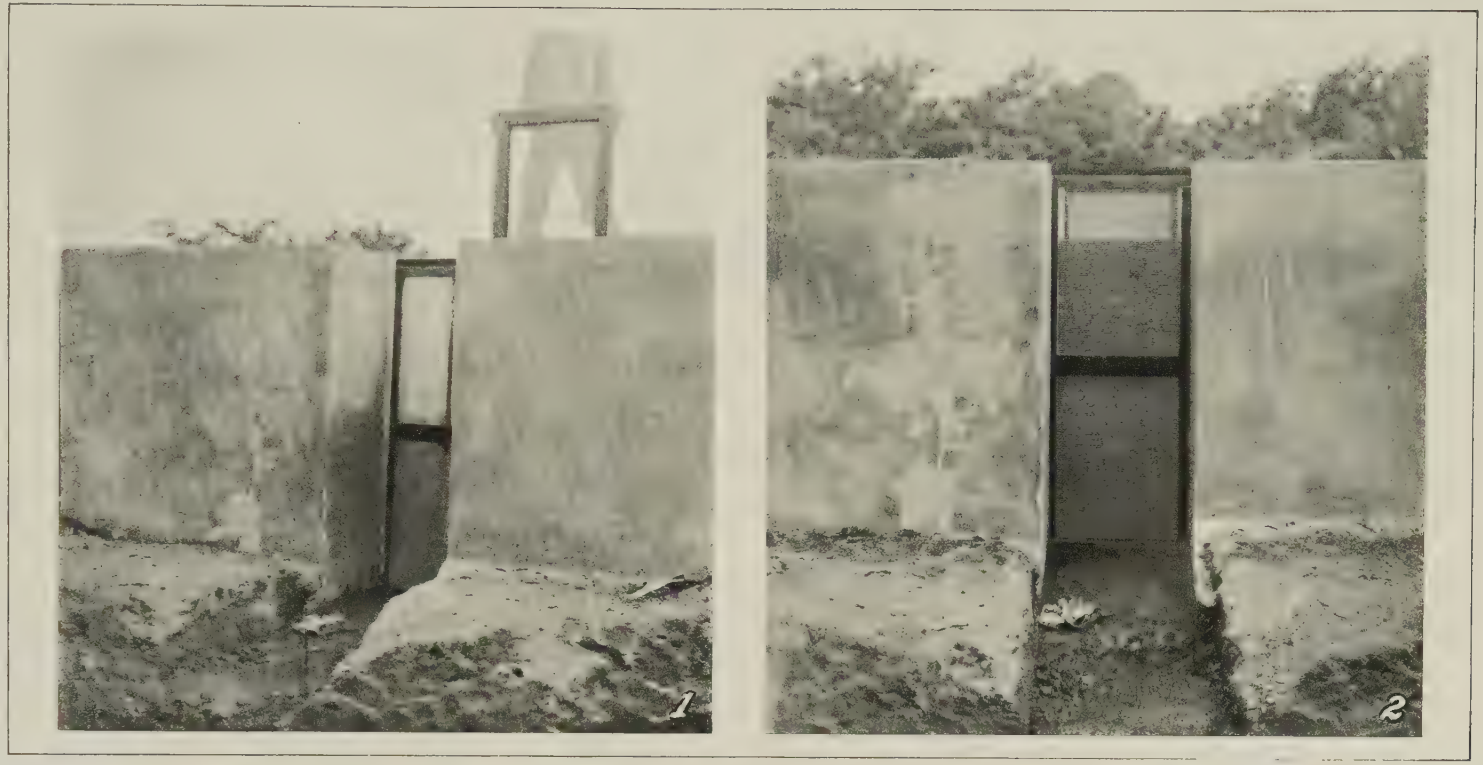


PLATE 8.

PLATE 9.

PLATE 10.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

Asia directory; a complete and up-to-date guide to the principal manufacturers, exporters, importers, merchants, shipping and insurance companies, banks, commercial and governmental organizations, etc. 1936–37 edition. Yokohoma, The Asia Directory Publishing Company. Price, Y16.96.

BARNARD, K. H. Amphipoda. (The John Murray Expedition, 1933–34, Scientific Reports, v. 4, no. 6, pp. 131–201.) London, The Trustees of the British Museum, 1937. Price, 5s.

The Economics of isolation. Pamphlet series No. 5, The American Academy of Political and Social Science, Phila., 1937. 54 pp. Price, paper, $0.50.

ELLIS, HAVELOCK. Psychology of sex; a manual for students. Emerson Books, inc., New York, 1937. 377 pp. Price, $3.

EVANS, W. H. Catalogue of the African Hesperiidae indicating the classification and nomenclature adopted in the British Museum. London, Printed by order of the Trustees of the British Museum, 1937. 212 pp., plates. Price, £1.

British Museum (Natural History). Diptera of Patagonia and South Chile. Part VII, Fascicle 3, Calliphoridae. Sarcophaginae by David Hall; Calliphorinae by John Smart. London, The Museum, 1937. pp. 347–384. Price, paper, 2s.

HICKSON, S. J. The Pennatulacea. (The John Murray Expedition, 1933–34, Scientific Reports, v. 4, no. 5.) London, Printed by order of the Trustees of the British Museum, 1937. pp. 109–130. Price, 2s.

LAUFER, STEPHEN. Yeast fermentation and pure culture systems, by Stephen Laufer and Robert Schwarz. New York, Schwarz laboratories, inc., 1936. 107 pp., illus. Price, $2.50.

New York State Traffic Commission. Creating safer communities. New York, The Commission, 1937. 48 pp.

RIKER, A. J., and R. S. RIKER. Introduction to research on plant diseases; a guide to the principles and practice for studying various plant-disease problems. St. Louis, J. S. Swift, 1936. 117 pp. Price, $2.50.

SHELDON, A. E. Land systems and land policies in Nebraska; a history of Nebraska land public domain and private property. (Nebraska state historical society. Publications, v. 22). The Society, Lincoln, 1936. 383 pp., illus., maps. Price, $3.50.

SHEPHARD, C. Y. The cacao industry of Trinidad. Series III and IV. Trinidad, Gov't print. off., 1937. 101 pp.

SMITH, A. R. H. A Carolina rice plantation of the fifties. 30 paintings in water-color, by Alice R. Juger Smith, narrative by Herbert Ravenel Sass, with chapters from the unpublished memoirs of D. E. Huger Smith. New York, William Morrow and Co., 1936. 97 pp., front., col. plates. Price, $10.

STAHL, AGUSTIN. Estudios sobre la flora de Puerto Rico. Con un prologo de Carlos E. Chardon. 2da. ed. tomo 1. San Juan, Puerto Rico, Publicaciones de la Federal Emergency Relief Administration, 1936. 343 pp.

STEVENS, BLAMEY. The identity theory. 2d ed., rev. and amplified. Manchester, Sherratt & Hughes, 1936. 143+xvi pp., tables, diagrs. Price, 7s. 6d.

STIASNY, G. Scyphomedusae. (The John Murray Expedition, 1933–34, Scientific Reports, v. 4, no. 7, pp. 203–242) London, The Trustees of the British Museum, 1937. Price, 5s.

VERE HODGE, E. H. Birch's management and medical treatment of children in India and the Tropics. 8th ed. Calcutta, Thacker, Spink & Co. (1933) ltd., 1936. 377 pp., illus. Price, Rs. 7–8.

WALKER, J. C. Diseases of vegetable crops. Ann Arbor, Michigan, Photolithoprint reproduction of author's manuscript by Edwards brothers, 1936. 65 pp. Price, $1.60.

WARREN, CARL. On your guard! the prevention and treatment of sex diseases. Foreword by Mr. J. Exner. New York, Emerson books, inc., 1937. 142 pp., front., illus., diagrs. Price, $1.

REVIEWS

The British Plastics Year Book 1937. The Handbook and Guide to the Plastics Industry. Plastics Press Ltd., London, 1937. 602 pp., illus. Price, 15s.

This standard book on plastics gives an account of the materials used in plastics, and the progress of this industry in Great Britain. Special chapters are devoted to methods of manufacturing cellulose plastics, methacrylate resins, synthetic resins from aniline condensation products, and similar topics. The book also gives the names and addresses of the firms interested in the plastic industry as well as the proprietary and general commercial names used. It has a section devoted to the numerous products made from plastics, and another section that contains useful data for manufacturers of these products.—A. P. W.

Diagnostic Criminology. By Lowel S. Selling. 1st ed. Edwards Brothers, Inc., Ann Arbor, Michigan, 1935. 175 pp. Price, $2.25.

This brief manual of scientific criminology may well serve as a practical guide to every scientific service in relation to criminal or juvenile court clinics. The variety and nature of the material treated in this book, together with the technical diagnostic procedures recommended, affords very useful information to all

persons interested in the modern application of criminology to social needs. The goal in view is that physicians, lawyers, psychologists, and sociologists could derive practical means for adjusting themselves to the exacting demands of their official or social duties and services on matters pertaining to criminals and crimes.

The author has succeeded in gathering and summarizing, with special ability, the enormously extensive data concerning the social, legal, biological, and medical aspects of criminology, and in evaluating them carefully on the basis of their practical merit and application.

The book consists of only 175 lithoprinted pages, and its present edition is limited to 350 copies, for economic reasons and to have the opportunity to add gradually comments, criticisms, and suggestions for a later edition. Nevertheless, none of the essential information on modern criminology has been neglected, and the technique of examinations for diagnostic purposes and treatment have been described with remarkable completeness. Its contents include, aside from the definition and historical introduction of the subject, the examination of adult and juvenile offenders, the important syndromes common to the adult offenders and those particularly found in the juvenile offenders, and recommendations concerning treatment of different clinical cases. The appendix, containing some illustrative cases and the extensive carefully prepared bibliography arranged according to a classified division of the subject, are noteworthy.—S. A.

Doctor Colwell's Daily Log for Physicians; A Brief, Simple, Accurate Financial Record for the Physician's Desk. Champaign, Ill., Colwell Publishing Company, 1937. Price, $6.

This volume consists of blank forms. All financial data on each patient can be conveniently recorded in this excellent record system for medical practitioners. Forms are also provided for monthly and yearly summaries of income and disbursements. Special records are also provided for inoculations, narcotics dispensed, obstetrical cases, surgical operations, notifiable diseases, and deaths.—P. S. S.

Essentials of Cardiography. By H. B. Russell. J. and A. Churchill Ltd., London, 1936. 82 pp., illus. Price, 7s. 6d.

This little compendium of cardiography is a concise clear outline of what students should know about graphic examinations for the most common cardiac ailments.

The facts are given in clear terms, and after reading the book one should get a good perspective of the whole subject that ought to create in an interested reader enough enthusiasm to spur him on to more intensive study.

The book is good not only for students but also for practitioners who may not have much time to devote to reading more extensive treatises on cardiography.—W. L.

Euthanasia and Other Aspects of Life and Death. By Harry Roberts. London, Constable and company, 1936. 278 pp. Price, 7s. 6d.

The book is made up of essays covering a wide range of subjects on euthanasia, on love and sex, on crime and punishment, on mind and reason, on education of the child, and on various sociological subjects, including sterilization of the ineffective. Most interesting of all is the discourse on euthanasia and the English Voluntary Euthanasia Legalization Bill. The bill seeks to legalize voluntary euthanasia under very limited and strict conditions so as to avoid abuse in its practice. The author should have specified whether the bill was enacted or not. The other subjects are of passing interest to a casual reader. Sociologists will probably find this book of some interest.—I. F.

Fleas as a Menace to Man and Domestic Animals: Their Life-History, Habits and Control. By James Waterston. 3d ed. rev. by P. A. Buxton. British Museum (Natural History) Economic Series III. Printed by order of the Trustees of the British Museum, London, 1936. 20 pp., illus. Price, 4d.

This pamphlet is a valuable contribution to the subject of fleas, which transmit the bacillus of bubonic plague. It points out that some fleas transmit certain types of endemic typhus, that a certain flea acts as the intermediate host of a tapeworm, in the adult state, in both dog and man, and other pertinent information.

The pamphlet is so well illustrated and simply written that the layman can understand it without difficulty. It sums up our present-day knowledge of the life history, habits, and various ways of control of fleas.—G. C. B.

The Gold-Exchange Standard in the Philippines. By George F. Luthringer. (Princeton University Department of economics and social institutions. International finance section. Publications, v. 4) Princeton University Press, 1934. 291 pp. tables, charts. Price, $3.

This book describes the Philippine Gold Standard Act of 1903 which provided a mechanism for maintaining the parity

of the silver peso with a theoretical gold peso containing 12.9 grains of gold 0.900 fine, a unit with a gold content precisely half that of the United States gold dollar. This was accomplished by establishing the Gold Standard Fund which consisted of silver coins held in the Treasury in Manila and dollar deposits in Banks in the United States.

Partly for the reason that in Oriental countries there is a tendency for the gold to disappear from circulation to be hoarded or converted into jewelry and partly for economic reasons, the purpose of the Philippine Gold Exchange Standard was to establish a form of gold standard that would function automatically without the necessity of circulating gold coin or maintaining a reserve of gold coin or bullion in the Islands.

The Gold Exchange Standard Act and the Silver Certificate Reserve Act were later superseded by the Currency Reserve Fund Act, creating the Silver Certificate Reserve which provided for the maintenance of the parity of the currency with gold through acting as a regulator fund which also served as redemption fund for treasury certificates, thus allowing the people to secure coins or notes as they desired.

The creation and operation of the Philippine National Bank is also described; in this description is reviewed the gradual dissipation of the currency reserve, through the inefficiency and ignorance of the basic principles of the currency system by the responsible officials of the bank and the Insular Treasury.

Such modifications as: (*a*) Disposition of part of the Gold Standard Fund in Philippine banks, and (*b*) The investment of part of the Gold Standard Fund in the Philippines, which were introduced after several years of operation of the Gold Exchange and the Silver Certificate Reserve, contravened with the basic principles of operation of a sound currency system. These modifications resulted in the dissipation of almost four-fifths of the dollar balance of the currency reserve, and would have resulted in a complete collapse of the Gold Exchange Standard mechanism if the Silver Certificate Reserve Act had not superseded the Gold Standard Fund as regulator of the fund of the currency system.

The book also describes the desperate attempt of the Insular Government to prevent financial chaos, which resulted in tampering with the currency reserve which would have resulted in the closing of the Philippine National Bank but for the adverse political financial effects such a step would have.

The book contains valuable footnotes, references, and statistics obtained from authentic official documents, besides a bibliography. To those who are interested in the study of the relationship of the Philippine peso to the United States dollar and to students of banking, finance, and currency measures, this book is an invaluable guide.—D. A.

Handbook for the Amateur Lapidary. By J. Harry Howard. Published by S. H. Howard, Greenville, S. C., 1935. 140 pp., illus. Price, paper, $2.

The Handbook for the Amateur Lapidary, although evidently intended for amateurs, is comprehensive enough to be useful also to the professional lapidary. It not only gives valuable information in the art of cutting and polishing gems and the equipment required, but is also good reading for a man who wishes to have a scientific knowledge of the physical properties of gems, their behavior to light, and the proper way of orienting and disposing them in order to enhance their optical properties. Useful information is also given about artificial coloring of certain gems. This book is also useful to mechanical engineers who design mechanical equipment for the lapidary and the mineralogist, as well as for gem collectors and carving and engraving men.—Q. A. A.

On the Incidence of Anaesthetic Complications and their Relation to Basal Narcosis. By C. J. M. Dawkins. Foreword by Joseph Blomfield. Published for the Middlesex Hospital Press by John Murray, London, 1936. 56 pp. Price, 3s. 6d.

This is a volume of practical experiences on the action of different anæsthetics, together with their complications and their relation to basal narcosis. It is a worthy and useful guide to be consulted when one is in doubt as to what anæsthetic should be administered.—C. D. F.

Our Enemy the Termite. By Thomas E. Snyder. Comstock Publishing Company, Inc., Ithaca, New York, 1936. 196 pp., plates, figs. Price, $3.

This book is based largely on experience gained by the author since 1909. It treats the termite from both the economic and the entomological point of view, for, as the author indicates, it is impossible to prescribe a method for control until the type of termite concerned and its life history are understood. The book discusses various species of termites, their distribution, their life history and cast system, their physiology and behavior, their food and enemies, and guests which sometimes dwell in

termite colonies. It points out the damage done by termites to woodwork of buildings, to boats, poles, mine props, to stored materials, to living vegetation, to nursery stock, young plantation stock, and vineyards, to shrubs, flowers, and greenhouse stock, and to field crops and grazing land.

The author discusses two general methods of termite control; namely, biological and artificial. For the former, he enumerates various parasites, but points out that because of the life of termites in darkness, and because of their constant activity, termites are among the very few forms of insect life that do not harbor internal insect parasites; he also enumerates various predators, including man. For the latter the author emphasizes that termites may be permanently controlled by eliminating all wood from foundations, cellars, basements, and porches—these structures to consist of masonry or concrete, in the case of houses of masonry as well as those having a wood superstructure. Various remedial control measures are also suggested and described.

The appendix specifies the remedy of termite damage to various types of buildings and contains a form on which a building inspector can record the important facts concerning termite damage and for insuring protection against termites and decay.

Although the book is fully authoritative and highly scientific, it is so well illustrated and simply written that it can be easily understood by the intelligent layman.—G. C. B.

Textbook of Meat Inspection. By J. Drabble. Angus & Robertson Ltd., Sydney, Australia, 1936. 353 pp., illus. Price, 21s.

The book is well conceived and, due to the extensive experience of the author, well carried out. It is divided into two parts: The first part gives the fundamentals in anatomy and physiology, the knowledge of which is very necessary to technical men and laymen engaged in meat inspection work; the second part deals essentially with the basis of meat inspection.

In view of the importance in meat inspection of the knowledge of what constitutes food animals, a chapter on food animals and methods of slaughtering and dressing is included. Then come discussions of meat inspection, including the ancient and modern methods of meat inspection practiced in various progressive countries; preservation of meat, with emphasis on the different processes of preservation practiced in meat-producing countries; and veterinary pathology, bacteriology, and parasi-

tology, discussed on levels within the province of meat inspection, including the judgment on each case involving a pathological condition.

The book is well written, in crisp and easy language. The discussions are brief but comprehensive. The summary and review questions at the end of each chapter will be of great aid to the reader.

With supplementary demonstrations of the lesions of animal diseases from preserved specimens, as the book is not so profusely illustrated, it would serve as a satisfactory textbook for students in meat inspection. The technical, experienced men, as well as the students and lay meat inspectors, will profit from this volume.

This book will deservedly find a place as a text or reference of great value in this field.—R. A.

Toxicology or the Effects of Poisons. By Frank P. Underhill. Thoroughly revised by Theodore Koppanyi. 3d ed. P. Blakiston's Son & Company, 1936. 325 pp. Price, $2.50.

This book is a convenient reference for busy medical practitioners. The chapter on the principles of toxicology is one of its strongest points. The other chapters are: Inorganic poisons—Corrosive Acids, Alkalies, Poisonous Gases, Metallic Poisons, Alkaloidal Poisons, Miscellaneous Organic Poisons. —D. P.

The Use of Vegetable Dyes for Beginners. By Violetta Thurstan. Rev. ed. Dryad Press, Leicester, London, 1936. 51 pp. Price, paper, $0.75.

This practical and comprehensive method of dying wool with vegetable dyes is useful for amateur dyers who are more interested in the production of brilliant and varied colors than in the fastness of the colors in the dyed fabric.—F. A.

Vitamin and mineral Therapy. By Casimir Funk. New York Vitamin corporation, 1936. 94 pp.

Volumes of information in a nutshell is the outstanding quality of this book. The work is by no means entirely original. It consists of a brief but comprehensive summary, rightly called a practical manual, of the work of leading authorities, such as Sherman, Rose, Cameron, Eddy, and others, incorporated with the author's own scientific investigations on nutrition. At the same time the authors introduced a new balanced vitamin requirement for different age groups in figures quite different from those introduced by the League of Nations in a conference

at Geneva in 1936. There are 617 references and 318 authors and experimenters cited in the book, material that even the best read persons may find it difficult to finish reading during a lifetime.

While the book is full of practical and up-to-date information on vitamins, very little is said of minerals as one would expect from the title of the book. Moreover, the general make-up of the volume is not that of a book on therapy in which a reader expects more emphasis on the physiology, physical appearance, commercial preparations, indications and contraindications to administration, and dosage. Physiology and normal bodily requirements of vitamins are fairly well covered, however, despite the fact that there is still a wide range of conflict as to the vitamin requirements of normal individuals. At least the amount and mode of administration of various commercial vitamin and mineral preparations should have been included if the authors wished to justify the title they selected for the book.

During perusal of the book and after computations numerical errors were noted in Table III, page 23.—I. F.

The Wine Book of South Africa; The Western Province of the Cape and its Wine Industry. "Wine and Spirit," Stellenbosch, South Africa, 1936. 224 pp. Price, ₱3.

This books deals mostly with the history of wine making and its industrial development in the southern part of Africa, especially in the Cape of Good Hope, where the growth of the finest wine grapes is favored by the best climatic condition.—F. A.

INDEX

[New names and new combinations are printed in **boldface**.]

A

Abo, 234.
Abortion, infectious, of swine, 265.
Aboy bating, 245.
Accipiter virgatus gularis (Temm. and Schlegel), 186.
Acisoma, 66–69.
  panorpoides Rambur, 25, 76.
Actinostema racemosum, 422.
Acyrthosiphon **rhododendri** Takah., 8, 9, 10
Æschna guttatus Burm., 43.
  jaspidea, 41.
Æschnidæ, 24, 25, 39.
Æschnophlebia, 39, 40.
Aëtobatus narinari (Euphrasen), 234, 235.
Agrionoptera Brauer, 65, 67, 68, 70.
  bartola Needham and Gyger, 24, 70, 71.
  quatuornotata Brauer, 24, 70.
  sexlineata Brauer, 72.
Alabu, 410.
Alamang, 192.
Albacore, 215; striped, 215.
Alcedo atthis bengalensis Gmel., 188.
Alectis indicus (Rüpp.), 234.
  sp., 234.
ALEXANDER, CHARLES P. Richard Crittenden McGregor, 359; New or little-known Tipulidæ from eastern Asia (Diptera), XXXV, 365.
Aligasin, 204.
Aliso, 234.
Allosetodes **assimilis** Banks, 160.
  plutonis, 160, 161.
Alsó, 192.
Amanita, 281, 282; a new species of, 281.
  aspera Fr., 282.
  manilensis Mendoza and Leus-Palo, 281, 282.
  muscaria, 282.
  phalloides, 282.
Ambassis spp., 192, 205, 217.
Amphiæschna, 39, 40, 43, 46.
  sp., 44.
Amphorophora lespedezæ Essig and Kuwana, 6.
Anabas testudineus (Bl.), 433.
Anaciæschna Sélys, 39–41.
  jaspidea Burm., 24, 41.
Anax Leach, 39, 40, 42.
  gibbosulus Rambur, 24, 42, 43.
  guttatus Burm., 24, 42, 43.
  jaspidea, 41.
  julius Brauer, 24, 42, 43.
Anchovy, 215, 233, 234; deep-bodied, 235.
Anguilla mauritiana Benn., 192, 204, 214, 216.
  spp., 433.
Anguillidæ, 193, 216.
Anisocentropus **nitidus** Banks, 156.
Anisodera **dense** Uhmann, **103.**
  humilis, 103, 104.
Anisoptera, 24; Philippine, 25.
Ankylopteryx, 142, 143, 149.
  anomala, 143.
  borneensis, 144.
  braueri Banks, 142, 144.
  candida, 144.
  claggi Banks, **143**, 144, 149.
  doleschali, 142, 144.
  nervosa, 144.
  nonelli, 142, 144.
  obliqua, 144.
  octopunctata, 144.
  perpallida, 144.
  polygramma, 144.
  punctata, 144.
  sigillaris, 144.
  trimaculata, 142, 144.
Anodontostoma chacunda (Ham.-Buch.), 216, 234.
Anomalagrion hastatum, 26.
Anopheles maculipennis, 327.
Ant thrush, red-breasted, 188.
Anthreptes malacensis griseigularis Tweedd., 187.
Anthus hodgsoni Richmond, 187.
  richardi lugubris Walden, 187.
Antocha (Antocha) bifida Alex., 382.
Aphid fauna of Formosa (Hemiptera), 1.
Aphis, 15.
  arundinariæ Takah., 12.
  bambusæ Fullaway, 12, 14.
  odinæ van der Goot, 15.
  plantaginis Schrank, 15.
  stranvaesiæ Takah., **14**, 15.
Apta, 192.
Arado, 234.
Arakaak, 234.

Araran, 234.
Archæomicromus, 137.
gratus, 138.
igorotus, 137.
nigrifrons, 138.
pictipes, 138.
placidus, 138.
pusillus, 138.
Arridæ, 216.
Arius leiotetocephalus Blkr., 233, 235.
spp., 216, 235.
Artamus leucorynchus leucorynchus (Linn.), 187.
Artemia, 332.
Arundinaria niitakayamensis Hay., 14.
Asiatic golden plover, 186.
kingfisher, 188.
swallow, 187.
Asohos, 192.
Atherina spp., 216.
Atherinidæ, 216.
Atoloy, 234.
Atyidæ, 192.
Auxis spp., 235.
thynnoides Blkr., 215, 218, 220.
Avifauna of Catanduanes, 185.
Awal, 234.
Azuma elegans, 53.

B

Bacillus pestis, 273.
Bacterium lactis ærogenes Escherisch, 332.
Baculihan, 192.
Bagaong, 192, 234.
Bakoko, 234.
Balanak, 234.
Balao, 235.
Bald starling, gray-backed, 188.
Balisokan, 234.
Banak, 192.
Banded cavalla, 234.
pomadasid, 235.
slipmouth, 235.
Bañgalonon, 234.
Bañgayñgay, 192.
Bangkolis, 234.
Bañgos, 193.
BANKS, NATHAN, Philippine neuropteroid insects, 125.
Banogon, 234.
Barira, 234.
Barorog, 234.
Barracuda, 215, 235.
Bass, black, 434; sea, 216, 234, 441; white sea, 216.
Batoidei, 235.
BELLOSILLO, GERVASIO C., Herpetomonas muscarum (Leidy) in Lucilia sericata Meigen, 285; The biology of Moina macrocopa Straus with special reference to artificial culture, 307.
Belonidæ, 216, 234.
Benincasa, 424, 425.
cerifera Savi., 410, 411, 422, 424, 425.
Big-eyed scad, 234.
Billyfish, 216.
Bilong-bilong, 234.
Bimb, 410.
Biyá, 192.
Black and white fantail-flycatcher, 188.
bass, 434.
Black-finned shark, 234.
Black-naped flycatcher, 187.
Bleeding-heart pigeon, 188.
Blue-spotted sting ray, 234.
Bolgan, 234.
Bolinao, 234.
Bonito, 235; oceanic, 215.
Books, 111, 259, 351, 467.
Borirawan, 234.
Bornia, 149.
Brachionus rubens, 326, 346.
Brachydiplax Brauer, 66–69, 79.
chalybea Brauer, 25, 80.
duivenbodei Brauer, 25, 80.
Brachythemis, 21, 66–69.
contaminata F., 25, 94.
Brahminy kite, Malayan, 188.
Broad-billed roller, 186.
Brucella, 265, 271, 272, 275, 276.
infection (infectious abortion) of swine in the Philippines, 265.
abortus Bang, 269, 270, 272–275.
abortus suis Traum, 265–268, 270, 272–274, 276.
melitensis, 272, 273.
suis, 271, 273.
Buan-buan, 192.
Buca dulce, 234.
Bugiw, 234.
Bulan-bulan, 234.
Bulbul, guava, 187; Philippine, 187; wattled, 187.
Burao, 234.
Buray, 234.
Butastur indicus (Gmel.), 186.
Butorides striatus javanicus (Horsf.), 186.
Butterfish, 193, 216.
Buzzard, crested honey, 186; tic-wee, 186.

C

Cæcilius, 128.
aridus, 128.
castillus, 128.
cincticornis, 128.
claggi, Banks, 128, **130.**
conspicuus Banks, 128, **129.**
deceptus, 128.
dolobratus, 131, 132.
guttulatus, 128.
inaequalis, 128.
marcidus Banks, 128, **129.**
muggenburgi, 128.
nitoris Banks, 128, **130.**
otiosus Banks, 128, **131.**
plagosus Banks, 128, **131.**
reductus, 128.
Calamoceratidæ, 156.

Caliphæa consimilis, 26.
Calliope calliope calliope (Pall.), 187.
Calœnadinæ, 175, 183.
Calœnas nicobarica Cassin, 183.
nicobarica nicobarica Linn., 183.
Camacinia, 23, 66–68.
gigantea Brauer, 25, 86.
othello Tillyard, 86.
Capella megala (Swinhoe), 186.
Carangidæ, 193, 213, 215, 219, 221.
Caranx armatus (Forsk.), 215.
crumenophthalmus (Bloch), 234.
djedaba (Forsk.), 215, 218, 220.
ignobilis (Forsk.), 192, 195, 196, 198, 213–215.
kallas (Cuv. and Val.), 215, 218, 220, 235.
leptolepis (Cuv. and Val.), 215, 218, 220, 235.
malabaricus (Bloch and Schn.), 215.
marginatus Gill, 192, 195, 196, 198, 212, 214, 215.
sexfasciatus (Quoy and Gaim.), 234.
sp., 192, 195, 196, 234, 235.
Carcharhinus melanopterus (Quoy and Gaim.), 234.
sp., 198.
Carp, 434.
Carpophaga metallica, 176.
Catfish, 433, 434; sea, 216, 233–235.
Cavalla, 234, 235; banded, 234.
Cavariella capreæ F., 10, 12.
capreæ Theo., 10.
japonica Essig and Kuwana var. **nigra** Takah., **10.**
neocapreæ Takah., 11.
pastinaceæ Linn., 12.
Centropus viridis (Scop.), 186.
Cephalæschna, 39, 40.
Cephalandra, 419, 425.
indica, 410–412, 416, 419, 420, 422, 423, 425, 426.
Ceratocheilus taiwanicola Alex., 401.
Chachanda, 410.
CHAKRAVARTY, H. L. Physiological anatomy of the leaves of Cucurbitaceæ, 409.
Chalcophaps indica Walden, 182.
indica indica Linn., 182.
Chalkumra, 410.
Chanidæ, 215.
Chanos chanos (Forsk.), 192, 193, 195, 196, 199, 214, 215, 219, 221, 433.
Charadrius dubius dubius Scop., 186.
Chichinda, 410.
Chichinga, 410.
Chimarrha, 170.
alticola Banks, **171.**
leucophlebia Navas, 171, 172.
luzonica, 171.
recta, 170.
tagalica Banks, **171.**
Chirocentrus dorba (Forsk.), 234.
Chorinemus lysan (Forsk.), 215.
Chrysocera Weele, 149.
Chrysopa, 142, 143, 147, 149.
alticola, 148.
apoana Banks, **146,** 148, 149.
atrioris, 148.
azygota, 148.
bakeri, 147–149.
boettcheri E. Peters., 149.
buruana E. Peters., 148, 149.
caliptera, 147.
derota Banks, **145,** 148.
eurycista, 147.
excelsior Banks, **144,** 148.
faceta Navas, 148.
flaveola, 147, 149.
formosana E. Peters., 149.
herasi Navas, 149.
ilota, 148.
inconspicua Navas, 149.
isolata, 148.
maquilingi, 148, 149.
mindanensis Banks, **146,** 148.
morota Bks., 148, 149.
nigribasis Bks., 143, 144, 148, 149.
notulata Banks, **145,** 148.
obliquata, 147–149.
procubitalis Navas, 148.
rizali, 147, 149.
ruficeps McLach., 147–149.
splendida Weele, 147–149.
tagalica, 148, 149.
unicolor Navas, 149.
valdezi, 147.
winkleri Navas, 148, 149.
Chrysopidæ, 142.
Cinara juniperi DeG., 2.
Cintameva, 149.
Cisticola cisticola cisticola (Temm.), 187.
Citrullus vulgaris, 422.
Cladocera, 307–309, 311, 327.
Clarias spp., 433.
Climbing perch, 433.
Clupeidæ, 215, 219, 221, 223.
Clupeoides lile (Cuv. and Val.), 234.
Cockatoo, Philippine, 188.
Coleoptera, 103.
Collocalia troglodytes Gray, 186.
whiteheadi whiteheadi Grant, 186.
Columba Linn., 175.
albicapilla Gmel., 182.
dussumieri Temm., 177.
griseigularis Salv., 176.
humilis Temm., 178.
indica Linn., 182.
phasianella Temm., 179.
pileata Scop., 182.
striata Linn., 181.
vitiensis Quoy and Gaim., 176.
vitiensis griseogularis (Walden and Layard), 176.
Columbinæ, 175.
Coniopterygidæ, 153.
Coracina striata striata (Bodd.), 187.
Cordulegaster savi, 26.
Cordulegasteridæ, 24, 25.
Corduliinæ, 24, 52, 57, 61.

Corvus coronoides philippinus Bp., 188.
COSME, LUZ LL., *see* MARAÑON and COSME.
Coucal, red-winged, 186.
Cow-nosed ray, 235.
Crab, 233, 235.
Cratilla Kby., 66–68, 94.
lineata Brauer, 25, 94.
metallica Brauer, 25, 94.
Crested honey buzzard, 186.
Crevalle, 234; deep-bellied, 215; deep-bodied, 235; yellow-stripped, 235.
Crithidia leptocoridis, 289.
Croaker, 233; large-mouthed, 234; plain, 235; whiskered, 235.
Crocothemis, 66–69.
servilia Drury, 25, 96.
Crow, Philippine, 188.
Cryptolabis trichopoda, 396.
(Bæoura) **angustilobata** Alex., **396**, 397.
(Bæoura) **consona** Alex., **397**.
(Bæoura) **lævilobata** Alex., **397**.
(Bæoura) setosipes Alex., 397.
(Bæoura) trichopoda Alex., 397.
Cryptomeria, 366.
Cuckoo, rough-crested, 186; scale-feathered, 186; Sino-Malayan hawk, 186.
dove, slender-billed, 188.
shrike, Luzon, 187.
Cucumis melo, 420, 422, 424.
melo Linn. var. momordica, 410, 411, 420, 423.
sativus, 410, 411, 418, 420, 422–424.
Cucurbita, 424, 425.
ferinosa Blm., 425.
hispida Wall., 425.
pepo DC., 410, 411, 413, 418–423, 425, 426.
pepo Lour., 425.
Cucurbitaceæ, 409–411, 417–426; bibliography, 427; physiological anatomy of the leaves of, 409.
Cunninghamia, 366.
Cutlass fish, 234.
Cyanocharis valga, 26.
Cybium commerson (Lacép.), 215, 218, 220, 235.
Cyclops, 346.
Cyprinus carpio Linn., 434.
Cypselurus oligolepis (Blkr.), 216.
spp., 235.

D

Dacinen, 105.
Dalag, 192.
Dalagan, 192.
Damagan, 192.
Damos, 234.
Dañgat, 192.
Dapak, 234.
Daphnia, 307, 309, 327.
macrocopus Straus, 308, 344.
magna, 332.
sp., 309.
Daphnidæ, 309.
Daragan, 234.
Dasyatis kuhli (Müller and Henle), 234.
Dasylophus superciliosus (Cuv.), 186.
Decapoda, 235.
Decapterus kurra Blkr., 215, 218, 220.
macrosomus Blkr., 215, 218, 220.
Deep-bodied anchovy, 235.
crevalle, 215, 235.
herring, 235.
pristipomid, 235.
Derby's tailorbird, 187.
Devil ray, 235.
Dhundul, 410.
Dicæum obscurum Grant, 187.
papuense (Gmel.), 187.
Dicranomyia depauperata Alex., 373.
fullawayi Alex., 373.
machidai Alex., 382.
sordida Brun., 373.
Dicrurus hottentottus balicassius (Linn.), 188.
Dilis, 234.
Diplacina, 21, 23, 66–69, 77.
bolivari Sélys, 25, 77–79.
braueri Sélys, 25, 77, 78.
nana Brauer, 25, 77.
phoebe Ris, 77.
sp., 78, 79.
Diplacodes Kby., 65, 67–69, 73.
nebulosa F., 24, 74.
trivialis F., 24, 73, 74.
sp., 74.
Diplectrona, 163, 164.
bidens, 164.
cinctipennis, 163.
exquisita Banks, 163, **165**.
fasciata, 164–166.
fasciata var. **stigmatica** Banks, **164**.
scabrosa Banks, **164**.
tricolor Banks, 163, **165**.
trifasciata, 163.
Diptera, 105, 365.
Dipterygonotus leucogrammicus Blkr., 216, 219, 221.
Do-al, 234.
Dolichopeza (Nesopeza) **fabella** Alex., **370**.
(Nesopeza) pallidithorax de Meij., 371.
(Sinoropeza) **paucisetosa** Alex., 369.
(Sinoropeza) pluricoma Alex., 370.
Doloclanes Banks, 168.
alticola Banks, 169.
montana Banks, 169.
Dorosomidæ, 216.
Dove, Dussumier's turtle, 186; slender-billed cuckoo, 188.
Drepane, 235.
punctata (Linn.), 235.
Drongo, northern, 188.
Dusky flowerpecker, 187.
Dussumier's turtle dove, 186.

E

Eagle, Philippine serpent, 186.
ray, spotted, 234, 235.
Echeneis naucrates (Linn.), 234.

Echinocystis lobata Torr. and Gray, 414.
Ecnomus rizali Banks, 170.
Eel, 193, 433; fresh-water, 216; piko, 235.
Egret, little white, 186.
Egretta garzetta nigripes (Temm.), 186.
Eichornia crassipes (Mart.), 442.
Elasmobranchii, 235.
Elegant titmouse, 187.
Elopidæ, 216.
Elops hawaiiensis (Regan), 216.
Engraulidæ, 215, 218–221, 223, 233.
Epenephelidæ, 216, 219, 221.
Epenephelus spp., 216, 217.
Epipsocus lingiceps Endl., 133.
preminens Banks, 132.
Epitheca, 23, 60.
heterodoxa Sélys, 60.
Epophthalmia, 52.
elegans Brauer, 24, 52.
Eriocera chrysomela (Edw.), 389.
davidi Alex., 389.
obliqua Alex., 389.
Eriopterini, 389.
Erratum, 401.
Euptilosus urostictus urostictus (Salv.), 187.
Eurya sp., 8.
Eurystomus orientalis orientalis (Linn.), 186.
Euthynnus yaito Kishinouye, 215, 218, 220.
Everett's weaver, 188.
Excalfactoria chinensis lineata (Scop.), 186.
Exocœtidæ, 215.

F

Fagaceæ, 4, 6.
Fagraea fragans, 412.
Fantail flycatcher, black and white, 188; rufous-bellied, 188.
Fimbriated herring, 234.
Fish, cutlass, 234; flying, 216, 235; guitar, 234; sergeant, 234; silverbar, 234; spade, 193.
farming in the Philippines, fresh-water, 433.
Fisheries of Lake Taal, Pansipit river, and Balayan Bay, Batangas Province, Luzon, 191.
Fishery industries of San Miguel Bay, 227.
Flame-colored snapper, 235.
Flaming sunbird, 187.
Flatfishes, 235.
Flathead, 234.
Flavobacterium aurescens (Rav.), 332.
diffusun (Frankland), 332.
Flowerpecker, dusky, 187; Harterts', 187; Parson's, 187; Philippine, 187; rusty, 187.
Flycatcher, black and white fantail, 188; black-naped, 187; gray-spotted, 187; long-tailed, 187; rufous-bellied fantail, 188.
Flying fish, 216, 235.
Folga luzonica Navas, 135.
Four-lined theraponid, 234.
Fresh-water eel, 216.
porgy, 234.
Frigate mackerel, 215.

G

Gabi, 447.
Gallicolumba luzonica, 188.
sp., 188.
Ganomena pallicorne McLach., 157.
Garfish, 216, 234.
Geopelia striata Walden, 181.
striata striata Linn., 181.
Geopeliinæ, 175, 181.
Gerrardanthus, 417.
Gerres filamentosus Cuv., 234.
Ghia turai, 410.
Giant goramy, 434, 439.
Ginger, effect of decortication on Philippine, 405.
Gizzard shad, 216; long-finned, 235; short-finned, 234.
Glenochrysa, 149.
Glossogobius giurus (Buch.-Ham.), 192, 206.
Gnophomyia dejecta Alex., 396.
(Gnophomyia) dejecta Alex., 396.
Goatfish, 216; yellow-striped, 235.
Gobiidæ, 215, 219, 221.
Gœra conclusa, 154.
disparilis Banks, 154.
impar Ulmer, 154.
Gœrinella apoana Banks, 155.
bicolor Banks, 155.
Gol kaddu, 410.
Golden plover, Asiatic, 186.
Golden-lored silvereye, 187.
Gomphidæ, 24, 25, 28.
Gomphidia, 28, 32.
karschi, 30.
kirschii Sélys, 24, 30–32.
Gonomyia, 394.
nubeculosa, 390.
skusei, 391, 392.
(Lipophleps) anxia Alex., 392.
(Lipophleps) atrox Alex., 393, 394.
(Lipophleps) conquisita Alex., 391.
(Lipophleps) inquisita Alex., 390.
(Lipophleps) nubeculosa de Meij., 391.
(Lipophleps) pallidisignata Alex., 391.
(Lipophleps) sauteri Alex., 392.
(Lipophleps) subanxia Alex., 391.
(Ptilostena) teranishii Alex., 394.
Goramy, 439; giant, 434, 439; three-spotted, 439.
Gourami, 439.
Gouramie, 439.
Gouramy, 439.
Grapsidæ, 192.
Grass warbler, rufous, 187.
Grasshopper warbler, yellow, 187.
Gray snapper, 193; silver-spotted, 234.
Gray-backed bald starling, 188.
Gray-spotted flycatcher, 187.
Gray-throated sunbird, 187.
Green heron, Javan, 186.

Greenidea nigra Maki, 4.
nigra Maki var. **kanzanensis** Takah., **3**, 4.
Grouper, 216, 234, 235.
Grunt, 216; thick-lipped, 235.
Guava bulbul, 187.
Guitar fish, 234.
GYGER, MAY K., *see* NEEDHAM and GYGER.
Gymnastes (Gymnastes) shirakii (Alex.), 390.
Gymnostema cissoides, 422.
Gynacantha Rambur, 39, 40, 46.
basiguttata Sélys, 24, 46.
bayadera Sélys, 24, 46, 48.
hyalina Sélys, 24, 46, **48**.
javica, 46.
subinterrupta Rambur, 24, 46, **47**.
sp., 49.

H

Halcyon smyrnensis gularis (Kuhl), 186.
Halfbeak, 216, 234.
Haliastur indus intermedius Blyth, 188.
Hammerhead shark, 234.
Hanging parakeet, Philippine, 186.
Hardtail, 215, 235.
Harengula tawilis Herre, 192, 206.
spp., 215.
Hartert's flowerpecker, 187.
Haustor catus (Linn.), 434.
Hawk, Japanese sparrow, 186.
cuckoo, Sino-Malayan, 186.
Helicoconis notata Navas, 153.
Heliogomphus, 28.
bakeri Laidlaw, 24, 36, 38.
Heliosmylus fraternus, 150.
monticolus Banks, **149**.
Helius (Helius) **aciferus** Alex., **384**.
(Helius) anæmicus Alex., 384.
(Helius) **hæmorrhoidalis** Alex., **383**.
(Helius) obliteratus Alex., 385.
Hemerobiidæ, 137.
Hemerobius baguiensis Navas, 142.
claggi Banks, 140, **141**.
inversus Navas, 142.
rizali Banks, 140, 142.
tagalicus Banks, 140, 142.
vagans Banks, 140, **141**.
Hemianax, 39, 40.
Hemichelidon griseisticta griseisticta Swinhoe, 187.
Hemicordulia, 52, 57.
assimilis, 57.
mindana Needham and Gyger, 24, **64**.
Hemiptera, 1.
Hemiramphidæ, 216, 234.
Hemiramphus far (Forsk.), 234.
quoyi (Cuv. and Val.), 214, 216.
Henicoptera, 105.
Henicoptera-Arten der Philippinen (Diptera), 105.
cuneilinea Hering, 106, **108**.
flavofemoralis Hering, 106, **107**.
interrupta Hering, 106, **107**.
proditrix O. S., 105–107.
spoliata Hering, **106**.
HERING, MARTIN, Die Henicoptera-Arten der Philippinen (Diptera), 105.
Heron, Javan green, 186.
Herpetomonas 288, 289, 292–298.
muscarum (Leidy), 285–288, 290, 293, 294, 298, 299.
muscarum (Leidy) in Lucilia sericata Meigen, 285.
Herring, 215, 233; deep-bodied, 235; fimbriated, 234; transport, 234.
Heteronaias Needham and Gyger, 57, **60**.
heterodoxa Sélys, 23, 24, 60–63.
sp., 62.
Heterosomata, 235.
Hexatoma rubrescens, 387, 388.
(Eriocera) chrysomela (Edw.), 389.
(Eriocera) davidi Alex., 389.
(Eriocera) obliqua (Alex.), 389.
(Eriocera) **quadriatrata** Alex., **387**.
Hexatomini, 386.
Hierococcyx fugax hyperythrus (Gould), 186.
Hirundo tahitica javanica Sparrman, 187.
Hispinen von den Philippinen, 103.
Homalomyia, 294.
Honey buzzard, crested, 186.
Houndfish, 216.
Huro floridana (Le Sueur), 434.
Hyacinths, water, 442.
Hydra, 326, 346.
Hydrilla, 447.
verticillata, 444.
sp., 335.
Hydrobasileus, 66–69.
croceus Brauer, 25, 87.
Hydropsyche faurci Navas, **162**.
forcipata Ulmer, 161.
rizali Banks, **161**.
Hydropsychidæ, 161.
Hydropsychodes, 162.
albocincta Banks, **162**.
costalis, 162.
excisa, 162.
marmorata, 163.
masi Navas, 162, 163.
normalis Banks, **162**.
Hynnis momsa Herre, 215.
Hypothymis azurea Grant and Whitehead, 187.

I

Ianthoenas griseogularis Walden and Layard, 176.
Ictinogomphus, 28.
clavatus, 32.
melænops, 29.
tenax Sélys, 24, 29.
Ictinus, 32.
Idiocera, 394.
(Idiocera) teranishii (Alex.), 394.
(Ptilostenodes) ptilostenella (Alex.), 395.
(Ptilostenodes) **uniplagiata** (Alex.), **394**, 395.
Idionyx, 23, 57.
philippa Ris., 24, 58.
sp., 59.

Idiophya Fraser, 57.
salva Needham and Gyger, 24, 57.
Igat, 192, 204.
I-ito, 234.
Ilisha hoevenii Blkr., 215.
Indæschna Fraser, 39, 40, 43.
baluga Needham and Gyger, 24, 44.
grubaueri Forst., 43, 44.
Indian pipit, 187.
Indomacromia, 57.
Inermiid, whiting-like, 216.
Inermiidæ, 216.
Infectious abortion of swine in the Philippines, 265.
Insects, Philippine neuropteroid, 125.
Insignis, 70.
Iole philippensis philippensis (Gmel.), 187.
Island painted quail, 186.
Itang, 234.

J

Jack, 215.
Jagoria Karsch, 40.
pœciloptera Karsch, 40.
pœciloptera Martin, 40.
Janthœnas vitiensis griseogularis Hachisuka, 176.
Japanese sparrow hawk, 186.
Javan green heron, 186.
Jhinga, 410.
Jhingaka, 410.
Johnius æneus (Block), 234.
Juniperus squamata Lambert, 3.

K

Kabalyas, 234.
Kabasi, 234.
Kadu, 410.
Kakrol, 410.
Kangkong, 447.
Kanoos, 235.
Kapis, 235.
Karala, 410.
Karela, 410.
Karkataka, 410.
Kasag, 235.
Katabá, 192.
Katang, 192.
Kawag-kawag, 452.
Katwonus pelamis (Linn.), 215, 218, 220.
Khira, 410.
Kikiro, 234.
Kingfisher, Asiatic, 188; white-throated, 186.
Kini, 234.
Kiskisan, 234.
Kitang, 192.
Kite, malayan brahminy, 188.
Kokatoe hæmaturopygius hæmaturopygius (P. L. S. Müller), 188.
Kondha, 410.
Koron-koron, 234.
Kowa-kowa, 234.
Krosan, 234.
Kubkub, 242.
Kudimah, 410.
Kuhlia marginata Cuv. and Val., 192.
rupestris Lacép., 192.
Kumra, 410.
Kututumby, 410.

L

Lachnus saligna Gmel., 2.
tatakaensis Takah., 1.
Lactarid, 234.
Lactarius lactarius (Bloch and Schn.), 234.
Lagenaria, 409, 423.
vulgaris Seringe, 410, 411, 413, 418, 419. 421–424, 426.
Lalage, pied, 187.
nigra chilensis (Meyen), 187.
Lanius cristatus lucionensis (Linn.), 187.
Lañgaray, 192.
Langkoy, 234.
Laolao, 234.
Lapis, 234.
Lapo-lapo, 234.
Large-eyed scad, 215.
Large-mouthed croaker, 234.
Lates calcarifer (Bl.), 216, 217, 234, 441.
Lathrecista Kby., 66–68, 90, 91.
asiatica F., 25, 91.
Latidæ, 216.
Lau, 410.
Lauki, 410.
Lawihan, 234.
Lawi-lawi, 234.
Leaffish, 235.
Leatherjacket, 234; yellow, 215.
Leiognathidæ, 215, 219, 221.
Leiognathus equulus (Forsk.), 215, 217, 234.
fasciatus Lacép., 235.
insidiator (Bl.), 234.
leuciscus (Gthr.), 215, 219, 221.
ruconius (Ham.-Buch.), 235.
spp., 215.
Lepidogrammus cumingi (Fraser), 186.
Leptoceridæ, 157.
Leptocoma braziliana sperata (Linn.), 187.
flagrans (Oust.), 187.
jugularis jugularis (Linn.), 187.
Leptogomphus, 28.
semperi Sélys, 24, 35.
Lespedeza sp., 6.
LEUS-PALO, SIMEONA, *see* MENDOZA and LEUS-PALO.
Libellula, 27, 78.
Libellulidæ, 24, 25, 52.
Libellulinæ, 24, 52, 65.
Limnobia pusilla Lackschewitz, 382.
Limonia atrostriata, 376.
subradialis, 376.
(Alexandriaria) atayal Alex., 374.
(Dicranomyia) depauperata (Alex.), 373.
(Dicranomyia) fullawayi (Alex.), 373.
(Dicranomyia) morio, 371, 373.
(Dicranomyia) **pacifera** Alex., 371.
(Dicranomyia) rectidens Alex., 373.
(Dicranomyia) sordida (Brun.), 373.
(Euglochina) dignitosa Alex., 374.
(Geranomyia) apicifasciata Alex., 380, 381.
(Geranomyia) **contrita** Alex., 381.
(Geranomyia) fletcheri (Edw.), 382.

Limonia—Continued.
(Geranomyia) **fremida** Alex., 377, 378.
(Geranomyia) **gracilispinosa** Alex., 380, 381.
(Geronomyia) **kiangsiana** Alex., 375, 376.
(Geronomyia) **radialis** Alex., 379.
(Geranomyia) **sparsiguttata** Alex., 374, 375.
(Geronomyia) **spectata** Alex., 375, 378.
(Geronomyia) **subradialis** Alex., 378, 379.
(Geranomyia) tenuispinosa Alex., 379.
(Libnotes) **hassenana** Alex., 382.
(Limonia) **machidai** (Alex.), 382.
(Rhipidia) **triarmata** Alex., 374.
(Trypticomyia) **unisetosa** Alex., 373.
Limoniinæ, 371.
Limoniini, 371.
Linæschna, 39, 40.
Lison, 234.
Little ringed plover, 186.
white egret, 186.
Lockbreakers, 215.
Locustella ochotensis ochotensis (Middendorf), 187.
Lodlod, 234.
Long-finned gizzard shad, 235.
Long-tailed flycatcher, 187.
Loriculus philippinensis philippensis (P. L. S. Müller), 186.
Lucilia, 285, 293–295.
sericata Meig., 294, 299; Herpetomonas muscarum (Leidy) in, 285.
Luffa, 417, 422, 424.
acutangula, 410–413, 419, 421, 423, 424, 426.
aegyptiaca Mill., 411–413, 419, 421, 423, 424, 426.
Lumulukso, 192.
Lutianus malabaricus, 205.
Lutjanidæ, 193.
Lutjanus argentimaculatus (Forsk.), 192, 217, 234.
fulvus (Bloch and Schn.), 235.
malabaricus (Schn.), 234.
sp., 234.
Luzon cuckoo shrike, 187.
hanging parakeet, 186.
tarictic, 186.
Lyriothemis Brauer, 21, 66–69, 94.
cleis Brauer, 25, 69, 95, 96.
latro Needham and Gyger, 25, 95.
pachygastra, 69.
tricolor Ris, 95, 96.

M

McGregor, Richard Crittenden, 359.
Macgregoromyia Alex., 360.
Mackerel, 233; frigate, 215; short-bodied, 215, 234; Spanish, 215, 235; striped, 234.
Macrodiplax Sélys, 66–68, 80, 81.
cora Brauer, 25, 81.
Macromia, 52.
frœnata, 55.
gerstaeckeri Krüger, 24, 53.
negrito Needham and Gyger, 24, 53.
thalia Fraser, 55.
sp., 55.
Macromidia, 52.
samal Needham and Gyger, 24, 56.
shanensis, 57.
Macromiinæ, 24, 52.
Macropygia Swainson, 175, 179.
eurycera Tweedd., 179, 180.
phæa McG., 180.
phasianella borneensis, 175.
phasianella phæa Hachisuka, 179, 180.
phasianella phæa McG., 180, 181.
phasianella septentrionalis Hachisuka, 179, 181.
phasianella tenuirostris Bp., 175, 179, 180, 188.
phasianella tenuirostris Hachisuka, 179.
tenuirostris Bp., 179, 180.
tenuirostris phæa Hachisuka, 180.
tenuirostris tenuirostris Hachisuka, 179.
Macrosiphoniella, 10.
Macrosiphum euryæ Takah., 7, 8.
holsti Takah., 8.
smilaceti Takah., 6.
Malagapas, 234.
Malayan brahminy kite, 188.
Maliputo, 192.
Mamsa, 234.
Managat, 234.
Manipis, 192.
MANUEL, CANUTO G., A review of Philippine pigeons, V: Subfamilies Columbinæ, Geopeliinæ, Phabinæ, and Calœnadinæ, 175; the avifauna of Catanduanes, 185.
MARAÑON, JOAQUIN, and LUZ LL. COSME, Effect of decortication on the constituents of Philippine ginger, 405.
Marsh warbler, striated, 187.
Matang baka, 234.
Megalaspis cordula (Linn.), 215, 235.
Megalomus exillatus, 142.
Megalopidæ, 193, 216.
Megalops cyprinoides (Brouss.), 192, 205, 214, 216, 234.
Megalurus palustris forbesi Bangs, 187.
Melothria japonica, 422, 423.
MENDOZA, JOSE M., and SIMEONA LEUS-PALO, A new species of Amanita, 281.
Mene maculata (Bloch), 216, 218, 220.
Menidæ, 216.
Mesogomphus, 23, 28.
balneorum Needham and Gyger, 24, 33.
lindgreni Fraser, 34.
sp., 34.
Micrococcus auranticus (Schröter), 332.
flavus Lehm., 332.

Micromus, 140.
linearis Hagen, 140.
philippinus Navas, 138.
variegatus, 140.
(Archæomicromus) **gratus** Banks, **138.**
(Archæomicromus) igorotus Banks, 138.
(Archæomicromus) **nigrifrons Banks, 139.**
(Archæomicromus) pictipes Banks, 138.
(Archæomicromus) **placidus** Banks, **139.**
(Archæomicromus) pusillus Gerst., 138.
(Micromus) angustior Weele, 140.
Micropsocus **basali** Banks, **133.**
erosus Endl., 133.
Milipili, 234.
Milkfish, 215, 433.
Miscanthus, 17.
sp., 17.
Mobula spp., 235.
Moina, 308, 309, 344.
azorica Moneiz, 308, 344.
brachiata Jurine, 308, 344.
dubia Rich., 307.
fisherii Hellich, 308, 344.
flagellata Hudendorff, 308, 344.
macrocopa Straus, 307, 308, 313, 315, 326, 328, 332, 339, 344; biology of, with special reference to artificial culture, 307.
paradoza Weismann, 308, 344.
rectirostris Baird, 308, 323, 344.
sp., 307.
Mojarras, spotted, 234.
Molophilus assamensis, 397, 398.
gracilis, 397.
injustus Alex., 397.
kempi Alex., 398.
Momordica, 409, 414, 416, 417, 425, 426.
charantia Linn., 409–411, 414–419, 422–424.
cochinchinensis Spreng., 410, 411, 414–419, 422–424, 426.
dioica Roxb., 414, 416.
echinata Spreng., 409.
echinata Wall., 414.
rostrata Zimm., 416.
Moonfish, 216.
Moray, 234.
Motacilla flava simillana Hartert, 187.
Motomot, 235.
Mugil amarulus Cuv. and Val., 203, 204, 216, 217.
cæruleomaculatus Lacép., 203, 216.
ceramensis Blkr., 203, 204, 216, 217.
dussumieri (Cuv. and Val.), 216.
lepidopterus Fowler, 203, 204, 216.
macrolepis (A. Sm.), 203, 204, 216.
melinopterus (Cuv. and Val.), 203, 204, 216.
ogilby Fowler, 203, 204, 216, 217.
vaigiensis Quoy and Gaim., 203, 216.
spp., 192, 214, 233, 234, 433.
Mugilidæ, 193, 195, 196, 203, 216, 234.
Mullet, 193, 216, 233, 234, 433.
Mullidæ, 216, 219, 221.
Munia atricapilla minuta (Meyen), 187.
Murænesox cinereus (Forsk.), 235.
Muræniдæ, 234.
Murrel, 433.
Musca domestica, 294.
nebulo, 293.
Muslo, 192.
Myzocallis kuricola Mats., 18.

N

Nabilan, 235.
Naias, 447.
Nannodiplax, 65.
Nannophya, 65, 67, 68.
pygmæa Rambur, 24, 72.
NEEDHAM, JAMES G., and MAY K. GYGER, The Odonata of the Philippines, 21.
Needlefish, 216.
Nematolosa nasus (Bloch), 216, 235.
Nemipteridæ, 216, 219, 221.
Nemipterus japonicus (Bloch), 216.
taenipterus (Cuv. and Val.), 216.
Nenus, 140.
luzonica Navas, 140.
novitus Navas, 140.
Neoperla, 134.
apoana Banks, 135, **136.**
atripennis, 134.
bakeri, 134, 136.
claggi Banks, 134, **136.**
clarissa, 134.
consimilis, 134.
hermosa, 134.
incerta Klap., 135.
obliqua, 135, 136.
pallescens Banks, **135.**
pallicornis Banks, 135, **137.**
pastellsi Navas, 135.
recta, 135–137.
viscayana, 135.
Neothunnus macropterus Schlegel, 215, 218, 220, 221.
Neptunus pelagicus Linn., 233, 235.
Neurothemis Brauer, 66–69, 84.
palliata Rambur, 25, 85.
terminata Ris., 25, 85.
sp., 85, 86.
Northern drongo, 188.
willow warbler, 187.

O

Obod, 235.
Oceanic bonito, 215.
Odiophya **salva** Needham and Gyger, **57.**
Odonata, 22, 24; Philippine, 21.
Œcetina angusta Banks, 157.

Œcetis, 157.
apicipennis Banks, 157.
claggi Banks, 157.
crassicornis, 157.
pilosa Banks, 157, 158.
scutata Ulmer, 158.
separata Banks, 157, 158.
Œcetodella, 158.
Œnopopelia Blandf., 175, 178.
tranquebarica humilis Hachisuka, 178.
tranquebarica humilis (Temm.), 178, 179.
Ogaog, 235.
Oligoæschna Sélys, 39, 40.
buhri, 41.
pœciloptera Karsch, 24, 40.
zambo Needham and Gyger, 24, 40.
Oncocephala acutangula Gest., 103.
angulata Gest., 103.
bieristata Chapuis, 103.
philippinica Uhmann, 103.
Onopopelia humilis Shp., 178.
Onychothemis, 21, 66–68.
abnormis Brauer, 25, 92.
Ophicephalus striatus Bloch, 192, 206, 433.
Ophiocara aporos Blkr., 192.
Ophiodopelma multipuncta Hagen, 127, 128.
Orchithemis, 65, 67, 68.
pulcherrima Brauer, 24, 70.
Oriental tree sparrow, 188.
Orimarga (Orimarga) **exasperata** Alex., 385, 386.
(Orimarga) gymnoneura Alex., 386.
Oriele, Philippine, 188.
Oriolus chinensis chinensis Linn., 188.
Orogomphus Sélys, 25, 28.
atkinsoni, 28.
campioni, 28.
splendidus Sélys, 24, 27.
Orthetrum Newm., 66–69, 78, 88.
clelia Sélys, 25, 88.
glaucum Brauer, 25, 88.
lepturum, 89.
luzonicum Brauer, 25, 88.
sabina Drury, 25, 88.
sabinum, 89.
testaceum Burm., 25, 88, 89.
sp., 80.
Orthotomus derbianus Moore, 187.
Osmylidæ, 149.
Osoos, 235.
Osphronemidæ, 439.
Osphronemus goramy Lacép., 434, 439.
Otolithes argenteus Cuv., 234.

P

Pagi, 235.
Pagotpot, 235.
Painted quail, Island, 186.
Pakan, 235.
Palad, 235.
Palæmonetes, 235.
Palauan, 192.
Palos, 192, 204.
Palubug, 244.
Pampano, 215, 235.
Panglambang, 246.
Panimerus juniperi Theo., 2.
Pantala, 66–69.
flavescens F., 25, 87.
Parakeet, Luzon hanging, 186; Philippine racket-tailed, 186.
Paras, 235.
Parasemidalis **tagalica** Banks, 153.
Paratrichosiphum montanum van der Goot, 6.
niitakaense Takah., 5.
Paratropeza (Gymnastes) shirakii Alex., 390.
Parros, 193.
Parson's flowerpecker, 187.
Parus elegans Lesson, 187.
Parvar, 410.
Pasayan, 235.
Passer montanus saturatus Stej., 188.
Patalang, 244.
Pating, 235.
Patis, 192.
Patol, 410.
Patola, 410.
Pavul, 410.
Pelates quadrilineatus (Bl.), 234.
Penæus spp., 233, 235.
Penelopides panini manillae (Bodd.), 186.
Perch, climbing, 433.
Perlidæ, 134.
Pernis apivorus ptilorhynchus (Temm.), 186.
Phabinæ, 175, 182.
Philippine Anisoptera, 25.
bulbul, 187.
cockatoo, 188.
crow, 188.
flowerpecker, 187.
ginger, effect of decortication on, 405.
neuropteroid insects, 125.
Odonata, 21.
oriole, 188.
pigeons, 175.
racket-tailed parakeet, 186.
rail, 186.
serpent eagle, 186.
weaver, 187.
Phormia, 293.
Phunt, 410.
Phut, 410.
Phuti, 410.
Phylloscopus borealis borealis (Blasius), 187.
Physedra, 417.
Pied lalage, 187.
Pigeon, bleeding-heart, 188; Philippine, 175.
Piko eel, 235.
Pinus, 366.
Pipit, Indian, 187; spotted tree, 187.
Piprisoma aeruginosum (Bourns and Worcester), 187.
Pirak-pirak, 235.
Pitta erythrogastra Temm., 188.
Placuna placenta Linn., 233, 235.
Plain croaker, 234.
Platax orbicularis (Forsk.), 235.
Platycephalus spp., 234.

Plectorhinchus spp., 235.
Plotosidæ, 234.
Plover, Asiatic golden, 186; little ringed, 186.
Pluvialis dominica fulva (Gmel.), 186.
Pogapo, 235.
Polynemidæ, 216, 234.
Polynemus microstoma (Blkr.), 234.
spp., 216, 217.
Polyneura apicalis, 85.
Polyplectropus **grandis** Banks, 167.
ulmeri Banks, 168.
Pomadasid, banded, 235; spotted, 233, 234.
Pomadasidæ, 216.
Pomadasys hasta (Bl.), 205, 214, 216, 233, 234.
maculatus (Bl.), 235.
Pomfret, 235.
Ponicon, 235.
Porgy, fresh-water, 234.
Potamarcha Karsch, 66–68, 90, 91.
obscura Rambur, 25, 91.
Potamogon, 447.
Primula chinensis, 419.
Prioniturus discurus discurus (Vieillot), 186.
Prionochilus inexpectatus Hartert, 187.
parsonsi McG., 187.
Pristipomid, deep-bodied, 235.
Pristipomoides sp., 235.
Pristis spp., 235.
Procordulia, 23, 61, 62.
Pselliophora mcgregori Alex., 360.
Pseudocæcilius **innotatus** Banks, 128, **132**.
testaceus Endl., 132.
Pseudolimnophila descripta Alex., 387.
projecta Alex., **386**, 387.
Psocidæ, 125.
Psocus, 126.
alticolus Banks, **126**.
cinereus Endl., 126.
dolorosus Banks, **125**.
incomptus Banks, **126**.
Ptychoptera annandalei Brun., 369.
bellula Alex., **367**, 368.
clitellaria Alex., 368.
daimio Alex., 368.
formosensis Alex., 369.
japonica Alex., 368.
javensis Alex., **368**, 369.
sumatrensis Alex., 369.
Ptychopteridæ, 367, 369.
Purul, 410.
Pycnonotus goiavier goiavier (Scop.), 187.
Pygmy swiflet, 186.

Q

Quail, Island painted, 186.
Quercus serrata Thunb., 18.
spinosa David., 16.

R

Rachycentron canadus (Linn.), 234.
Racket-tailed parakeet, Philippine, 186.
Rail, Philippine, 186.
Rallus torquatus torquatus Linn., 186.
Raphismia, 65, 67, 68.
bispina Hagen, 24, 75.
Rastrelliger brachysomus Blkr., 215, 218, 220, 233, 234.
chrysozoma (Rupp.), 215, 218, 220, 234.
Ray, 235; blue-spotted sting, 234; cow-nosed, 235; devil, 235; spotted eagle, 234, 235.
Rayado, 235.
Red snapper, 193, 234.
Red-breasted ant thrush, 188.
sunbird, 187.
Red-tailed shrike, 187.
Red-winged coucal, 186.
Remora, 234.
Rhinoptera javanica (Müller and Henle), 235.
Rhipidura cyaniceps cyaniceps (Cassin), 188.
javanica nigrotorquis Vigors, 188.
Rhododendron oldhami Maxim., 10.
Rhopalosiphium lespedezæ Essig and Kuwana, 6.
Rhynchobatus djiddensis (Forsk.), 234.
Rhyothemis, 66–68.
phyllis Sulzer, 25, 84.
phyllius, 84.
Riring, 235.
Roller, broad-billed, 186.
Rompe, 235.
Rotifera, 309, 326, 327, 346.
Rough-crested cuckoo, 186.
Round scad, 215.
ROXAS, HILARIO A., and AGUSTIN F. UMALI, Fresh-water fish farming in the Philippines, 433.
Rubythroat, Siberian, 187.
Rufous grass warbler, 187.
Rufous-bellied fantail flycatcher, 188.
Rusty flowerpecker, 187.

S

Safed kumra, 410.
Salay-salay, 235.
Salix, 11.
fulvo-pubescens Hay., 10, 11.
sp., 2.
Samanea saman (Jacq.) Merr., 282.
Saminayon, 235.
San Miguel Bay, fishery industries of, 227.
Sangkad, 238.
Sapiao, 249.
Sarangan, 235.
Sarap, 245.
Sarcophaga, 294.
Sarcops calvus (Linn.), 188.
Sardinella fimbriata (Cuv. and Val.), 234.
perforata (Cantor), 215, 233, 235.
spp., 215.
Sardines, 215.
Sasa, 410.
Sawfish, 235.
Scad, big-eyed, 215, 234; round, 215.
Scale-feathered cuckoo, 186.
Scatophaga, 294.

Scatophagidæ, 193, 216.
Scatophagus argus (Bodd.), 192, 205, 214, 216.
argus (Linn.), 234.
Scendesmus, 309.
Schizopepon bryoniæfolius, 422.
Sciæna spp., 235.
Sciænidæ, 233.
Scoliochrysa, 147, 149.
Scoliodon palassorah (Cuv.), 234.
Scomberoides lysan (Forsk.), 234.
Scombridæ, 215, 219, 221, 228.
Scutengraulis sp., 235.
Sea bass, 216, 234, 441; white, 216.
catfish, 216, 233–235.
Selar crumenophthalmus (Bl.), 215, 218, 220.
Seopsis luzonica Banks, 134.
ticolor Banks, 133.
Sergeant fish, 234.
Sericostomatidæ, 154.
Serpent eagle, Philippine, 186.
Serranidæ, 234, 235.
Setodes, 157.
flavipennis Banks, 159.
spinosella Ulmer, 160.
Shad, gizzard, 216, long-finned gizzard, 235; short-finned gizzard, 234.
Shark, 235; black-finned, 234; hammerhead, 234; sharp-nosed, 234.
Sharp-nosed shark, 234.
Shell, window, 233, 235.
Short-bodied mackerel, 215, 234.
Short-finned gizzard shad, 234.
Shrike, red-tailed, 187; white-bellied swallow, 187.
Shrimp, 233, 235.
Siberian rubythroat, 187.
yellow wagtail, 187.
Siganid, 216, 235.
Siganus spp., 216, 217.
Siliw, 235.
Sillaginidæ, 235.
Sillago sihama (Forsk.), 192, 216, 217.
Sillagonidæ, 216.
Silver-bar fish, 234.
Silvereye, golden-lored, 187.
Silversides, 216.
Silver-spotted gray snapper, 234.
Sino-Malayan hawk cuckoo, 186.
Slender-billed cuckoo dove, 188.
Slipmouth, 215, 234; banded, 235; spotted, 235; wily, 234.
Small-mouthed threadfin, 234.
Smilax sp., 7.
Snapper, flame-colored, 235; gray, 193; red, 193, 234; silver-spotted gray, 234.
Snipe, Swinhoe's, 186.
Solotellina elongata (Lam.), 193.
Somatochlora, 23, 60–62.
Sorodan, 235.
Spade fish, 193, 216, 234.
Spanish mackerel, 215, 235.
Sparrow, oriental tree, 188.
hawk, Japanese, 186.
Sparus berda (Forsk.), 234.
Sphyræna jello Cuv. and Val., 215.
obtusata Cuv. and Val., 215.
spp., 235.
Sphyrænidæ, 215, 235.
Sphyrna zygæna (Linn.), 234.
Sphyrnidæ, 234.
Spiloconis interrupta Banks, 153.
Spilopelia chinensis tigrina, 178.
tigrina McG., 177, 178.
Spilornis holospilus holospilus (Vigors), 186.
Spilosmylus, 150.
alticolus Banks, 150, 151.
apoanus Banks, 151, 152.
formosus Banks, 150, 151.
inquinatus McLachl., 150, 151.
lineatus Navas, 151.
modestus Gerst., 150–153.
nephelius Navas, 151.
proximus Banks, 150, 151.
tuberculatus Walk., 151.
Spotted eagle ray, 234, 235.
mojarras, 234.
pomadasid, 233, 234.
slipmouth, 235.
tree pipit, 187.
Squid, 235.
Starling, gray-backed bald, 188.
Stenopsocus apertus, 127.
dissimilis Banks, 127.
infirmus, 127.
tonkingensis, 127.
Sting ray, blue-spotted, 234.
Stolephorus commersonii Lacép., 215, 234.
indicus (Van Hasselt), 215.
Stranvæsia niitakayamensis Hay., 15.
Streptopelia Bp., 176–177.
chinensis, 177.
chinensis palawana Hachisuka, 177, 178.
dussumieri Bp., 177.
dussumieri (Temm.), 177, 186.
dussumieri gutierrezi Hachisuka, 177.
humilis Bp., 178.
Striated marsh warbler, 187.
Striped albacore, 215.
mackerel, 234.
Stromateus niger (Bl.), 235.
Styringomyia acuta Edw., 399.
armata Edw., 398, 399.
lineaticeps Edw., 401.
mcgregori Alex., 360.
marshalli Edw., 401.
pendula Alex., 400.
separata Alex., 401.
soembana Edw., 401.
spathulata Alex., 398.
Suagan, 235.
Sunbird, flaming, 187; gray-throated, 187; red-breasted, 187; yellow-breasted, 187.
Surmullet, 216.
Sushavi, 410.
Swallow, asiatic, 187.
shrike, white-bellied, 187.
Swiflet, pygmy, 186; Whitehead's, 186.
Swine, infectious abortion in, 265.
Swinhoe's snipe, 186.

T

Tabal-tabal, 235.
Tabañgoñggo, 235.
Tabaroyan, 235.
Tailorbird, Derby's, 187.
TAKAHASHI, RYOICHI, Additions to the aphid fauna of Formosa (Hemiptera), IV, 1.
Talangka, 192.
Taligmanok, 235.
Talotoon, 235.
Tamban kasasion, 235.
Tangigi, 235.
Tarakitok, 235.
Tarictic, Luzon, 186.
Tarpon, 193, 216, 234.
Tawilis, 192.
Tayotos, 235.
Tegui, 235.
Telakucha, 410.
Telebasis salva, 26.
Tenpounder, 216.
Tetracanthagyna, 23, 39, 40, 51.
bakeri Camp., 24, 49–51.
Tetraneura radicicola Strand, 16, 17.
sp., 16.
Tetrathemis, 21, 23, 65, 67–69, 72.
irregularis Brauer, 24, 72, 73.
Teucholabis (Teucholabis) iriomotensis Alex., 389.
(teucholabis) **kiangsiensis** Alex., 389.
Teuthidæ, 216.
Teuthis javus Linn., 235.
sp., 216.
Theobaldia incidens, 327.
Therapon jabua (Forsk.), 192.
spp., 214, 216, 234.
Theraponid, 234; four-lined, 234.
Theraponidæ, 216.
Thick-lipped grunt, 235.
Tholymis, 66–69.
tillarga F., 25, 82.
sp., 83.
Thoracaphis distyllifoliæ Takah., 16.
quercicola Takah., 16.
tarokoensis Takah., 15.
Threadfin, 216, 234; small-mouthed, 234.
Three-spotted goramy, 439.
Thrush, red-breasted ant, 188.
Thrypticomyia arcuata Alex., 373.
Thunnidæ, 215, 223, 234, 235.
Thunnus germo (Lacép.), 215, 218, 220, 221.
Tic-wee buzzard, 186.
Tingarog, 235.
Tinodes **adjuncta** Banks, 167.
tagalica Banks, 166.
Tipulidæ, 359, 360, 365, 369.
from eastern Asia, 365.
Tipulinæ, 369.
Titmouse, elegant, 187.
Titso, 235.
TOPACIO TEODULO, Brucella infection (infectious abortion) of swine in the Philippines, 265.
Toros, 235.
Toxorhina (Ceratocheilus) taiwanicola (Alex.), 401.
Toxotes jaculator (Pall.), 192.
Tramea, 66–69.
limbata Desjardins, 25, 84, 86.
Transparent herring, 234.
Tree pipit, spotted, 187.
sparrow, Oriental, 188.
Trentepohlia (Mongoma) ricardi Alex., 360.
(Trentepohlia) mcgregori Alex., 360.
Triænodes, 160, 161.
boettcheri Ulmer, 159.
Trichiurus haumela (Forsk.), 234.
Trichogaster trichopterus (Pall.), 439.
Trichosanthes, 422, 424.
anguina Linn., 410, 411, 419–421, 423.
dioica Roxb., 410, 411, 419, 421, 423, 424.
Trichosiphum montanum van der Goot, 6.
Trithemis Brauer, 21, 66–68, 92.
aurora Burm., 25, 92, 93.
festiva Rambur, 25, 92, 93.
pallidinervis Kirby, 25, 92, 93.
Trypanosoma lewisi, 290.
raiæ, 288.
Tuna, 234, 235; yellowfin, 215.
Turai, 410.
Turiñgan, 235.
Turtle dove, Dussumier's, 186.
Turtur dussumieri Gray, 177.
humilis Walden, 178.
tigrina Shp., 177.
Tylosurus giganteus (Schlegel), 216.
melanotus (Blkr.), 216, 217.

U

Uchhya, 410.
UHMANN, ERICH, Zwei neue Hispinen von den Philippinen (Coleoptera), 103.
UMALI, AGUSTIN F., The fishery industries of San Miguel Bay, 227; *see also* ROXAS and UMALI.
Upeneoides mollucensis Blkr., 216.
sulphureus (Cuv. and Val.), 235.
vittatus Blkr., 216.
Upeneus indicus (Shaw), 216.
moana (Jordan and Seale), 216.
Uroloncha leucogastra everetti (Tweedd.), 188.
Urothemis, 21, 66–68, 80, 81.
bisignata Brauer, 25, 81.

V

Vallisneria sp., 335.
VILLADOLID, DEOGRACIAS V., The fisheries of Lake Taal, Pansipit River, and Balayan Bay, Batangas Province, Luzon, 191.
Vorticella, 327, 346.
sp., 326.

W

Wagtail, Siberian yellow, 187.
Warbler, northern willow, 187; rufous grass, 187; striated marsh, 187; yellow grasshopper, 187.

Water hyacinths, 442.
Wattled bulbul, 187.
Weaver, Everett's 188; Philippine, 187.
Whiskered croaker, 235.
White sea bass, 216.
White-bellied swallow shrike, 187.
Whitehead's swiflet, 186.
White-throated kingfisher, 186.
Whiting, 216, 235.
Whiting-like inermiid, 216.
Willow warbler, northern, 187.
Wily slipmouth, 234.
Window shell, 233, 235.

X

Xeocephus rufus rufus (Gray), 187.

Y

Yellow grasshopper warbler, 187.
leatherjacket, 215.
wagtail, Siberian, 187.
Yellow-breasted sunbird, 187.
Yellow-fin tuna, 215.
Yellow-striped crevalle, 235.
goatfish, 235.

Z

Zingiber officinale Rosc., 405.
Zosterops aureiloris Grant, 187.
Zygonyx, 65, 67, 68.
ida Karsch, 24, 76.
Zyxomma Rambur, 66–68, 81.
obtusum Sélys, 25, 81, 82.
petiolatum Rambur, 25, 81, 82.